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ANNUAL REPORT

ON THE

AGRICULTURAL EXPERIMENTS AND DEMONSTRATIONS

IN

ASSAM

FOR THE

YEAR ENDING THE 30TH JUNE 1916.

SHILLONG:
PRINTED AT THE ASSAM SECRETARIAT PRINTING OFFICE:

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CONTENTS.

ANNUAL REPORT OF THE JORHAT AGRICULTURAL EXPERIMENT STATION.

	Paras.	Pages.
Introduction	1	1—2
Soil analysis and report ...	2	2—5
Buildings and machinery ...	3	5
Rainfall and season	4	6—7
Experimental work	5	7
Sugarcane	6	7—8
Sugarcane Varieties—Ratoon Cane ...	7	8—13
Ditto „ —Plant „ ...	8	13—19
Ditto Planting experiment—Ratoon	9	19—22
Ditto „ „ —Plant Cane	10	22—25
Soil Investigations	11	26
Liming Experiment—Block G ...	12	26—27
„ and Manurial Experiment—Block C	13	27—32
Wood ashes experiment—Block C ...	14	32—33
Ground Limestone experiment—Block L	15	33—37
Agricultural Chemist's experiments—Block K	16	37—39
Flour Phosphate experiments ...	17	39—40
Extension area	18	40
Other crops (Maize, Cotton, Cowpeas for seed, Cowpeas varieties, green crops, etc.)	19	40—42
Fruit	20	42
Receipts and Expenditure ...	21	43
Establishment	22	43
Inspection	23	43

Map of Farm.

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ANNUAL REPORT OF THE UPPER SHILLONG AGRICULTURAL EXPERIMENT STATION.

	Paras.	Pages.
History and description... ...	1	47
Purposes of the station	2	47—48
Weather	3	48—49
Summary of work	4	49
Trial of varieties of potatoes ...	5	49—56
Potatoes for seed	6	56—58
Warping of rice-land	7	58
New crops	8	58—59
Fodder crops	9	60
Cattle breeding	10	61—62
Sheep breeding	11	62—63
Distribution of seeds and plants ...	12	63
Establishment	13	63
Receipts and expenditure ...	14	63

ANNUAL REPORT OF THE FRUIT EXPERIMENT STATION, SHILLONG.

	Paras.	Pages.
Introductory	1	64
Lower garden	2	64—65
Upper garden	3	65—67
Varieties planted	4	67—85
Statement of expenditure ...	...	85

ANNUAL REPORT OF THE KARIMGANJ AGRICULTURAL EXPERIMENT STATION.

	Paras.	Pages.
General	1	86
Character of land and soil ...	2	86
Equipment	3	86—87
Character of the year	4	87—88
Rice breeding	5	88—91
Minor experiments	6	91—96
Non-experimental crops... ...	7	96—97
Insect pest	8	97—98
Receipts and expenditure ..	9	98
Staff	10	98—99

ANNUAL REPORT OF THE KAMRUP SUGARCANE EXPERIMENT STATION.

	PARAS.	PAGES.
Introductory	1	100
Land	2	100—101
Rainfall	3	101—102
Soil	4	102
Communications	5	102
Buildings, fencing, etc. ...	6	102
Cattle	7	102
Water-supply	8	103
Labour	9	103
Cultivating tackle	10	103
Drainage scheme	11	103—104
Cane planted in April and May 1915	12	104—105
Extension area, season 1915-16 ...	13	105
Planting of present crop ...	14	105—106
Cane nursery	15	106
Other crops	16	106—107
Expenditure	17	107—108
Receipts	18	108
Staff	19	108
General	20	108
Report on Agricultural Demonstration in the Assam Valley, during the year ending the 30th June 1916 ...	1—12	109—120
Report on Agricultural Demonstration in the Khasi and Jaintia Hills District, during the year ending the 30th June 1916	1—8	121—126
Report on Agricultural Demonstration in the Surma Valley, during the year ending the 30th June 1916 ...	1—6	127—135

ANNUAL REPORT OF THE JORHAT AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING THE 30TH JUNE 1916.

Introduction.

This station is situated about 3 miles south of Jorhat, Sibsagar district, Assam Valley, and was established in the beginning of the year 1906. It was intended principally for sugarcane work. Since then, on account of peculiar soil conditions which altogether precluded the growth of most *rabi* crops even in the presence of abundance of soil moisture, the work has been extended to include a study of the factors causing this sterile condition with a view to its amelioration. This work has been going on since 1908, and we are now in a position to state that the sterile condition of the soil to most crops in the cold weather, and also to certain crops in the rains, is due to the accumulation of acid substances, amongst them being a specific toxin which has been isolated and experimented with in culture solutions, with effects on the plant's root system and growth precisely similar to those observed in the field; these are readily neutralised and rendered harmless by dressings of lime or other base to the soil. An account of the experimental results leading up to this conclusion has been published as a memoir of Department of Agriculture, Chemical Series, Volume III, No. 9, entitled "Studies of an Acid Soil in Assam."

In connection with the improvement of the soil by liming, the application of other fertilizers has been studied, and our regular scheme of manuring now includes green manuring and the application of raw phosphates. Phosphoric acid has an effect second only to that of lime on these soils, but is preferably used in a basic form, such as basic slag for instance, rather than in the form of acid superphosphate. While small initial applications of the latter act beneficially, its application in very large doses or its continued use over a number of years, in our own experience, is clearly detrimental in the absence of periodic lime dressings on sour soils. If used in conjunction with lime, however, the case is quite a different one.

The original area of the station was about 35½ acres, of which 1·7 acres is *hola* or ravine land and the remainder high land, which was under grass and scrub jungle at the time of acquisition. An additional area of about 24 acres has since been acquired, of which about 4 acres is *hola* land and the remainder high land. The total area at present is thus 59½ acres. Most of the newly-added area has been put under cultivation and is being treated uniformly in blocks with a view to future experiments.

Soil.

2. The soil of the high land is a reddish sandy loam of the old alluvium, lying on a hard greyish yellow sub-soil. Where the conditions have not been improved by cultivation, the soil is extremely shallow, varying from only 3 to 6 inches in depth.

The following report is by Mr. A. A. Meggitt, Agricultural Chemist, Assam :—

Report on analysis of Jorhat Farm soil.

—	Surface soil.	Sub-soil.
	Laboratory No. 5.	Laboratory No. 5(*a*).
1	2	3
Soluble in Hydrochloric acid with 12 hours' digestion at 100°C.	Per cent.	Per cent.
Phosphoric acid (P_2O_5)	0·025	0·020
Potash (K_2O.)	0·115	0·135
Lime (Ca. O.)	0·154	0·144
Magnesia (Mg. O.)	0·166	0·148
Soluble in 1 per cent. Citric acid with 7 days' digestion.		
Phosphoric acid	0·008	0·008
Potash	0·007	0·011
Loss on ignition (organic matter and combined water).	3·26	1·84
Nitrogen	0·114	0·051
Calcium carbonate	0·048	0·018
Reaction	Acid.	Acid.

Physical Constants.

—	Hygroscopic capacity.	Maximum water saturation capacity.		Minimum water saturation capacity.		Moisture in air-dry soil.
		Per cent. of water in saturated soil by weight.	Per cent. of water in saturated soil by volume.	Per cent. of water by weight.	Per cent. of water by volume.	
1	2	3	4	5	6	7
Surface soil	3·10	31·9	50·5	11·2	13·9	1·3
Sub-soil	...	30·0	50·0	7·2	9·1	1·19

These analyses agree quite well generally with some others made some years ago by the Imperial Agricultural Chemist.

These samples are acid in reaction, and the total lime present in all combinations, as well as the carbonate of lime, is quite deficient in quantity.

Carbonate of lime has an enormous influence on a soil's welfare chemically, physically and bacteriologically.

Its effects on soil biological processes are in the right direction and very great ; it also influences the texture of soils in a remarkable way, and is active in bringing into use the reserves of dormant plant food. Its presence in fair amount also ensures the most economical effect of any manuring given. Its absence forbids the use, for most cropping, of certain kinds of manures, unless liming be first resorted to.

Any upland soil containing such small amounts of total lime and lime carbonate as are here present will most certainly respond markedly in the case of most cropping to applications of lime.

The amount of organic matter is probably greater than obtains in many Indian soils, but there is no doubt that a light soil of this character will be much improved in many ways by an increase in the amount of humus.

A good deal of the organic matter present is of a doubtful character and consists very probably of very old residues of little value ; it is the presence and active decay of comparatively recent additions of organic matter which puts life into a soil.

The percentage of nitrogen present in the surface soil is what would normally be considered a fair one, but in view of the absence in anything like adequate quantity of carbonate of lime, conditions for nitrification and soil biochemical processes generally are probably not as favourable as they might be by a long way, and an increase in the amount of nitrogen is indicated as desirable.

Of potash there is no dearth, and there would seem to be no immediate need for potash manuring.

Regarding phosphoric acid, these samples show a deficiency both in " total " as well as " available " supplies. There is thus a " real " as opposed to a mere temporary lack in respect of this element of plant food.

This lack of phosphoric acid is further aggravated by the absence of sufficiently large amounts of lime carbonate and humus, high percentages of which may, and often do, offset a smaller percentage of phosphoric acid.

An acid condition of soil, besides being harmful in itself, very often brings about a more rapid depletion of the soil's stock of phosphoric acid, in consequence of which most soils of a decidedly acid character are found to be lacking in this element and to respond to its suitable application.

Turning to the physical constants, the hygroscopic capacity is low, and about what one would expect for this class of soil. It means that only water, which is in excess of about 3 per cent., is available for crops, and plants are able to reduce the soil moisture content to somewhere about this figure before they begin to wilt. The top 6 inches of soil even during the cold weather normally contains a good deal more moisture than 3 per cent. when under a close standing crop, so that usually there is sufficient water for the crop's requirements.

As regards maximum saturation capacity, these soils agree quite well with quoted figures for similar soils in Europe, and suggest that the optimum proportion of water for the growth of the plant is about 13 to 16 per cent. A recent determination of soil moisture in the surface 6 inches of the soil of this farm in

August, some few hours after rain, gave 17 per cent. water. Soil moisture conditions are therefore probably extremely favourable for growth during the rainy season in normal seasons.

The figures for minimum saturation capacity are much lower than those cited (Hall, The Soil, page 69) for similar soils in Europe, and this is probably due to the lower content of humus which obtains in our soils. This is an extremely important figure in gauging a soil's power to retain a reserve of moisture for crops during dry periods.

The sub-soil is worse in this respect than the surface layer, suggesting that the incorporation of organic matter, if it can be buried sufficiently deep, will have a great ameliorating effect.

The sub-soil is capable of very great improvement indeed as the figures show, but it would probably be immediately disastrous to work it so deeply as to bring any considerable amount to the surface at once.

The growth of deep-rooting legumes as green crops will assist materially, but if the sub-soil could be stirred occasionally, while at the same time the surface cultivation is gradually deepened so that green crops may be more deeply buried, a greater depth of surface soil will result, which on this farm is very much to be desired.

I am convinced that for cane cultivation, until the surface soil has been deepened and the amount of humus increased, it is of little use attempting manurial experiments on cane with artificial manures. No amount or combination of the latter can ever make up in the case of a crop like sugarcane for loss of fertility due to shallow cultivation and lack of " humus. "

Buildings and machinery, etc.

3. The farm is equipped with a godown, combined office, and rest-house, quarters for Farm Superintendent, Clerk and apprentices, and a cattle shed with brick walls and corrugated iron roof. A three roller 12″×18″ cane mill driven by a 9 B. H. P. Hornsby Oil engine was installed in 1911.

During the year the farm was completely enclosed by ideal wire fencing.

A Dutch Barn, 40′×20′, with corrugated iron roof and brick floor, and also a threshing floor 40′×40′ brick-on-edge and cement pointed, were constructed during 1915.

Rainfall.

4. The rainfall recorded during the growing period of the crops referred to is given in the following table together with the normal rainfall :—

Month.	Actual rainfall in inches.	Normal rainfall in inches.
1	2	3
1915 April	7·71	8·54
1915 May	25·03	9·26
1915 June	12·31	11·36
1915 July	15·28	14·76
1915 August	16·22	15·15
1915 September	10·85	9·18
1915 October	3·15	4·07
1915 November	Nil	0·69
1915 December	0·46	0·52
1916 January	1·26	0·93
1916 February	2·46	1·32
1916 March	5·61	3·90
Total	100·34	7968
1916 April	8·14	8·54

Remarks.

The annual fall was thus some 20 inches above normal and 32 inches in excess of the previous year. The chief excess occurred during May, when 25 inches were recorded against a normal 9. The spring months were thus marked by abnormal wetness, and the rain was so continuous as to seriously interfere with the growth of nearly the whole of the rains crops owing to the impossibility of any intercultivation being done under the soil condition obtaining. Weeds, which grew apace, could not be properly dealt with in consequence, and the result was disaster more or less complete to certain crops, particularly maize and *jowar*.

The early cold weather, *i.e.*, from mid October to the end of December was particularly dry, and although the *rabi* crops were sown on nice soil moisture, no showers fell for more than 2 months after sowing, most of the crops being short in consequence.

Experimental work.

5. The work of previous years was continued and extended under the following heads :—

I. Sugarcane experiments.
II. Soil investigations.
III. Trials of new crops, or new varieties of existing ones.
IV. Paddy Selection.

Sugarcane.

6. This year, though the demand for cane sets was far greater than usual (some 92,000 sets were sent out from the farm), it was largely met from a non-experimental area planted up last year for the purpose. As a consequence the experimental plots were not indented on to any large extent for planting material, so that in many cases the whole of each variety plot was experimentally treated at harvest time. This was not the case with all the experimental plots however, but in every case the whole of the cane of each plot stripped as for milling was weighed. About half the cane in such cases was milled, and the juice thus obtained sampled and analysed.

The season was not a good one for cane; the abnormally heavy rain of the spring months seriously retarded growth, despite special drainage measures undertaken. Added to this the cane was late in being planted owing to unavoidable causes. Jackals took a heavier toll of the crop than usual, and the cane moth borer, appearing to find climatic conditions suitable, did considerable damage. Our cane crops, therefore, in common with those of the whole of the Upper Assam Valley, were smaller and poorer than usual, particularly the ratoons.

It is very necessary to remark here that in order to advance our planting season, which owing to labour difficulties has been getting gradually later, it was decided to harvest the plots earlier this year and before they were quite ripe. Owing to late harvest and planting in the previous year, the crop had only 10 months growing period, and this is admittedly insufficient for the cane to ripen off its juice. The result is seen in the figures for juice composition. The above course was deliberately taken, knowing well what the result would be, in order to advance the planting season and get things on to a better footing. The newly planted cane is clearly much better in consequence and the results should be evident in next year's report.

Sugarcane varieties—Ratoon cane.

7. The following varieties planted in Block E in 1914 were ratooned:—

B 376
B 147
Striped Mauritius
} Two $\frac{1}{10}$ acre plots of each variety on the unphosphated area.

B 376
B 147
Striped Mauritius
} Two $\frac{1}{10}$ acre plots of each variety on the phosphated area.

In addition $\frac{1}{10}$th acre plots of B 208, *Gandari*, *Magh* sport, *Kheri* and Red Tanna were ratooned.

The results of the plant cane crop appeared in last year's report. Following usual practice, after plant cane harvest the land was hoed, all pieces of diseased and dead canes being removed and burnt. Two earthings were given during the rains, and the crop received 30 maunds rape cake per acre, half at each earthing. Stripping was done early in the cold weather.

The cane harvest began on the 21st January 1916 and finished early in February. The results are set out in Tables I and II, of which Table I shows the composition of the juice and Table II the weights of cane, juice, sugar, etc., per acre.

TABLE I.

Block E.—Ratoon Cane, 1915-16—(varieties.)

Juice.

Plot.	Variety.	Plot area.	Cane sugar.	Invert sugar.	Total sugar.	Glucose ratio.	Total solids.	Purity co-efficient.	Remarks.
1	2	3	4	5	6	7	8	9	10
		Acre.	Per cent.	Per cent.	Per cent.		Per cent.		
1	B 376	$\frac{1}{10}$th	14·86	*	...	...	16·7	89·0	The (*a*) plots were on the Phosphated area.
1*a*		$\frac{1}{10}$th	13·50	*	...	...	15·67	86·1	
4		$\frac{1}{10}$th	13·26	0·88	14·14	6·63	15·17	87·4	* Invert sugar not determined in these cases.
4*a*		$\frac{1}{10}$th	12·01	1·13	13·14	9·40	14·0	85·8	
2	B 147	$\frac{1}{10}$th	13·35	*	...	...	15·85	84·2	
2*a*		$\frac{1}{10}$th	13·90	*	...	...	16·4	84·8	
5		$\frac{1}{10}$th	14·08	0·97	15·05	6·88	16·3	86·4	
5*a*		$\frac{1}{10}$th	14·63	0·88	15·51	6·01	16·8	87·1	
3	Striped Mauritius	$\frac{1}{10}$th	13·23	*	...	...	15·5	85·4	
3*a*		$\frac{1}{10}$th	12·47	*	...	...	14·8	84·3	
6		$\frac{1}{10}$th	14·83	0·75	15·58	5·05	16·4	90·4	
6*a*		$\frac{1}{10}$th	13·65	1·05	14·70	7·69	15·97	85·5	

TABLE II.

BLOCK E.—RATOON CANE, 1915-16 (varieties.)

(*Figures are per acre*).

Plot.	Variety.	Plot area.	Cane.	Juice.	Juice on cane.	Total sugar in Juice.	Cane sugar in Juice.	Remarks.
1	2	3	4	5	6	7	8	9
		Acre.	lbs.	lbs.	Per cent.	lbs. per acre.	lbs. per acre.	
1	B 376	$\frac{1}{10}$th	41,680	25,950	62·26	...	3,856	The (*a*) plots were on the Phosphated area.
1*a*		$\frac{1}{10}$th	52,030	31,970	61·45	...		
4		$\frac{1}{10}$th	38,640	22,600	58·5	3,196	2,997	
4*a*		$\frac{1}{10}$th	48,900	30,050	61·45	3,949	3,609	
2	B 147	$\frac{1}{10}$th	37,780	24,190	64·03	...	3,230	
2*a*		$\frac{1}{10}$th	51,950	32,860	63·25	...	4,568	
5		$\frac{1}{10}$th	38,870	23,830	61·3	3,587	3,355	
5*a*		$\frac{1}{10}$th	54,720	34,350	62·78	5,328	5,025	
3	Striped Mauritius	$\frac{1}{10}$th	51,820	30,310	58·5	...	4,010	
3*a*		$\frac{1}{10}$th	62,630	38,040	60·75	...	4,744	
6		$\frac{1}{10}$th	47,680	27,740	58·2	4,322	4,114	
6*a*		$\frac{1}{10}$th	64,480	38,740	60·1	5,695	5,288	
	B 208	$\frac{1}{10}$th	29,600	Not analysed. Weight of cane per acre only taken.				
	Gandari	$\frac{1}{10}$th	24,600					
	Magh-Sport	$\frac{1}{10}$th	11,770					
	Kheri	$\frac{1}{10}$th	54,080					
	Tanna	$\frac{1}{10}$th	33,420					

The ratoon crop was not ripe at harvest, but for reasons stated in paragraph 6 it was decided to cut it to enable us to advance the planting season. The figures for juice composition are therefore not as good as usual, those for cane sugar and purity co-efficient being somewhat low, while the invert sugar and glucose ratio are higher than usual. The yield of cane being also smaller than usual on account of unfavourable season and depredations of jackals, the figures for cane sugar per acre are somewhat down.

The facts that the previous plant cane crop was unavoidably late harvested, that the past year was excessively wet, and that the incidence of moth-borer was greater than usual in the ratoons, all conspired to produce a ratoon crop which was distinctly below the average. Striped Mauritius did better than either B 147 or B 376, and the yield of the other varieties was very inferior to all the above.

Phosphate application.

As explained in last year's report, plots 1-6 were respectively the duplicates in other respects of plots 1*a*-6*a*, the only difference being that the latter plots were on an area which received Stane's Flour Phosphate in 1913.

While the plant cane crop from the non-phosphated area was slightly the greater last year (owing probably to the fact that the phosphate area produced a very much bigger crop of mustard in the cold weather preceding the planting of the cane), in the ratoons the phosphated plots have given a very considerably larger crop than the non-phosphated ones.

The figures for both crops are shown below, these being average figures for all three varieties :—

—	lbs. cane per acre (average of 6 plots).		
	Plant cane.	Ratoon.	Total.
1	2	3	4
Non-phosphated area	55,588	42,745	98,333
Phossphated area	51,755	55,785	107,540

It will be seen therefore that the application of Stane's Flour Phosphate in addition to giving a much bigger mustard crop in the first year of its use, has also raised the total cane crop by more than 4 tons cane per acre during the 2nd and 3rd years following its application. This experiment is being carried out on all the four blocks which come under the cane rotation.

Following the ratoon cane, the whole of the block was sown with *Dhaincha* for green manure, and the growth of this crop was throughout very much better on the phosphated area, this being the 4th year after its application.

Cowdung *versus* cake.

This experiment also included a trial of cowdung *versus* cake as a manure. The scheme was as follows :—

—	Plant cane.	Ratoons.
1	2	3
Plots 1—3 and 1*a*—3*a*	500 maunds cow-dung per acre.	30 maunds cake.
Plots 4—6 and 4*a*—6*a* ...	250 maunds cow-dung. 17½ maunds cake.	30 maunds cake.

The differential manuring was thus confined to the plant cane crop, the monetary value of the manuring being however the same. Both received identical manuring for the ratoon crop.

The figures for the two crops are shown below :—

—	Lbs. per acre of cane.		
	Plant cane.	Ratoons.	Total.
1	2	3	4
Cowdung plots (1—3 and 1*a*—3*a*) ...	55,493	49,648	105,141
Cowdung and cake plots (4—6 and 4*a*—6*a*).	51,860	48,882	100,742

The cowdung plots show a small advantage over the cowdung and cake plots.

Sugarcane varieties—plant cane.

8. Block B was the area to come under plant cane in the rotation this year. It was limed in 1910 at the rate of 50 maunds slaked lime per acre. In 1914, previous to green-manuring with cowpeas in preparation for cane again in 1915-16, one acre on the western side was dressed with 7 maunds Stane's Phosphate.

The planting scheme was as follows :—

B 376 B 147 Striped Mauritius	Duplicate $\frac{1}{10}$th acre plots of each variety on the unphosphated area.
B 376 B 147 Striped Mauritius	Duplicate $\frac{1}{10}$th acre plots of each variety on the phosphated area.
B 208 Gandari Magh Magh Sport Kheri Red Tanna	$\frac{1}{10}$th acre plots.

Block B was under plant cane in 1911-12, ratooned in 1912-13. It carried *aus* paddy and *matikalai* in 1913-14 without manure, followed by green-manuring with cowpeas during the rains 1914. A crop of mustard was taken in the cold weather of 1914-15. Sugarcane was planted in May 1915, planting being unavoidably late with consequent detriment to the crop, as will subsequently appear. The sets were transplanted from the Nursery in rows 4 feet apart.

As it was impossible to get cowdung, manuring was identical for all plots, *viz.*, 30 maunds rape cake per acre, applied in 3 doses of 10 maunds, one at planting, one at 1st earthing and one at 2nd earthing. Harvesting took place in March 1916. The results appear in Tables III and IV.

TABLE III.

Block B.—Plant Cane, 1915-16 (varieties).

Juice.

Plot.	Variety.	Plot area.	Cane sugar.	Invert sugar.	Total sugar.	Glucose ratio.	Total solids.	Purity co-efficient.	Remarks.
1	2	3	4	5	6	7	8	9	10
		Acre.	Per cent.	Per cent.	Per cent.		Per cent.		
1	B 376	$\frac{1}{10}$th	16·35	0·39	16·74	2·38	17·5	93·4	The (*a*) plots were on the phosphated area.
1*a*		$\frac{1}{10}$th	16·65	0·37	17·02	2·22	18·0	92·5	
4		$\frac{1}{10}$th	16·36	0·36	17·22	2·13	18·1	93·1	
4*a*		$\frac{1}{10}$th	16·67	0·39	17·06	·33	18·1	92·1	
2	B 147	$\frac{1}{10}$th	16·16	0·64	16·80	3·96	18·06	89·5	
2*a*		$\frac{1}{10}$th	16·31	0·59	16·90	3·61	18·16	89·8	
5		$\frac{1}{10}$th	16·57	0·59	17·16	3·56	18·45	89·8	
5*a*		$\frac{1}{10}$th	15·61	0·67	16·28	4·29	17·5	89·2	
3	Striped Mauritius	$\frac{1}{10}$th	16·42	0·50	16·92	3·04	17·87	91·9	
3*a*		$\frac{1}{10}$th	17·18	0·39	17·57	2·27	18·54	92·7	
6		$\frac{1}{10}$th	16·58	0·51	17·09	3·07	18·2	91·1	
6*a*		$\frac{1}{10}$th	16·57	0·53	17·10	3·19	18·34	90·4	

Magh	$\frac{1}{10}$th	11·22	1·45	12·67	12·92	14·53	77·2
Magh Sport	$\frac{1}{10}$th	13·24	0·98	14·22	7·40	15·96	82·9
B 208	$\frac{1}{10}$th	17·37	0·39	17·76	2·24	18·8	92·4
Tanna	$\frac{1}{10}$th	13·88	0·72	14·60	5·18	16·3	85·2
Gandari	$\frac{1}{10}$th	13·44	1·07	14·51	7·96	16·44	81·7
Kheri	$\frac{1}{10}$th	12·15	1·30	13·45	10·70	15·3	79·4

TABLE IV.

Block B.—Plant Cane, 1915-16 (varieties).

(*Figures are per acre*).

Plot.	Variety.	Plot area.	Cane.	Juice.	Juice on cane.	Total sugar in juice.	Total sugar in juice.	Cane sugar in juice.	Remarks.
1	2	3	4	5	6	7	8	9	10
		Acre.	lbs.	lbs.	Per cent.	Per cent.	lbs. per acre.	lbs. per acre.	
1	B 376	$\frac{1}{10}$th	60,560	36,360	60·04	16·74	6,087	5,945	The (*a*) plots were on the phosphated area.
1*a*		$\frac{1}{10}$th	49,800	29,760	59·76	17·02	5,065	4,955	
4		$\frac{1}{10}$th	54,120	32,472	60·0	17·22	5,592	5,475	
4*a*		$\frac{1}{10}$th	44,160	26,496	60·0	17·06	4,520	4,417	
2	B 147	$\frac{1}{10}$th	40,100	30,600	62·32	16·80	5,141	4,945	
2*a*		$\frac{1}{10}$th	37,764	23,300	61·7	16·90	3,938	3,801	
5		$\frac{1}{10}$th	49,690	30,475	61·33	17·16	5,230	5,050	
5*a*		$\frac{1}{10}$th	40,270	24,245	60·2	16·28	3,947	3,785	
3	Striped Mauritius	$\frac{1}{10}$th	54,430	32,120	59·0	16·32	5,435	5,275	
3*a*		$\frac{1}{10}$th	46,680	27,550	59·0	17·57	4,841	4,733	
6		$\frac{1}{10}$th	57,050	33,605	58·9	17·09	5,743	5,572	
6*a*		$\frac{1}{10}$th	50,490	29,690	58·8	17·10	5,077	4,920	

TABLE IV—*concld.*

Block B.—Plant Cane, 1915-16 (varieties).

(*Figures are per acre.*)

Plot.	Variety.	Plot area.	Cane.	Juice.	Juice on cane.	Total sugar in juice.	Total sugar in juice.	Cane sugar in juice.	Remarks.
1	2	3	4	5	6	7	8	9	10
		Area.	lbs.	lbs.	Per cent.	Per cent.	lbs. per acre.	lbs. per acre.	
	Magh	$\frac{1}{10}$th	31,470	18,700	59·4	12·67	2,370	2,098	
	Magh Sport	$\frac{1}{10}$th	29,640	16,030	54·1	14·22	2,280	2,123	
	B 208	$\frac{1}{10}$th	41,310	24,910	60·3	17·76	4,424	4,327	
	Tanna	$\frac{1}{10}$th	42,640	24,500	57·5	14·60	3,577	3,401	
	Gandari	$\frac{1}{10}$th	32,540	19,420	59·7	14·51	2,818	2,610	
	Kheri	$\frac{1}{10}$th	47,930	25,500	53·2	13·45	3,430	3,099	

The cane was obviously unripe at harvest, as owing to the fact that it was not planted till May 1915, it had only a 10-11 months' growing period. In consequence the figures for cane sugar in juice and purity co-efficient, though fairly high, are a little lower than usual, while the invert sugar and glucose ratio are somewhat higher. Nevertheless the figures for juice composition, bearing in mind the above facts and the adverse character of the season, may be considered very satisfactory. A comparison of the figures for the exotic varieties B 147, B 376 and Striped Mauritius, with those for the indigenous varieties, *e.g.*, *Magh*, *Tanna*, *Gandari* and *Kheri*, emphasises the fact that even under unfavourable conditions of season, etc., the introduced exotics easily lead the way. Thus, in a season and under such conditions when *Magh*—the variety chiefly cultivated by ryots in the Assam Valley—shows rather less than a ton of cane sugar per acre in the extracted juice, the exotic varieties on the average show well over 2 tons. *Magh*, of course, will do better than this year in a favourable season, but the exotics also do correspondingly better too.

There appears to be some evidence that B 147 is deteriorating slightly with us at Jorhat; probably conditions are not quite tropical enough for it in the Upper Assam Valley. It appears to find itself more at home in the lower parts of the valley, *e.g.*, in the Kamrup district.

In regard to differential manurial treatment, as was the case last year, so this year also the yields of cane per acre from the phosphated area are less than those from the unphosphated land, and for similar reasons I take it. Thus the average yield per acre of cane of all plots of the three varieties B 376, B 147 and Striped Mauritius is 54,158 lbs. for the unphosphated area as against 44,860 lbs. for the phosphated. This is some 9,000 lbs. cane per acre in favour of the unphosphated area, a greater difference than may be accounted for purely by experimental error. Thus as the figures in Table IV show, a difference amounting to some 6,000 lbs. per acre is possible between exact duplicate plots, plots 1 and 4, both of which were B 376 plots on the unphosphated area similarly manured and treated in every way, and yet showing a difference in favour of plot 1 of some 6,440 lbs. per acre of cane. A difference then up to 6,500 lbs. cane per acre could on the present year's results be put down to experimental error.

The difference in yield between the phosphated and unphosphated area can, I think, only be explained by the fact that during the preceding cold weather mustard was taken on both areas, and while it made a very heavy crop on the phosphated area, the yield from the unphosphated side was very poor indeed. The figures were as follows:—

Mustard grain.—Yield from one acre phosphated area 820 lbs.

Mustard grain—Yield per acre of non-phosphated area 164 lbs.

This large mustard crop on the phosphated side would carry off much available nitrogen, at least 50 lbs. per acre in grain and straw, much of which would otherwise have been available for the following cane crop. The removals of nitrogen from the non-phosphated area would be small, leaving more in the soil for the young cane. To test this theory this year on Block A the mustard crop instead of being removed has been ploughed in during flowering. As usual it made a very heavy crop on the phosphated area and practically no crop on the unphosphated side. The cane crop now on the ground up-to-date appears to be decidedly better on thephosphated area. The results will appear in next year's report.

Sugarcane Planting Experiment—Ratoons.

9. This experiment was laid out in Block F in 1914 to determine the optimum number of sets for planting, the rows being 4 and 5 feet apart respectively.

B 147 was the variety used, as there was reason to believe that it would respond better to wider planting than other varieties. Cultivation and manuring was the same as for the ratoon variety experiments. Other details in regard to this experiment will be found in paragraph 10 of last year's report, where also the results of the plant cane crop are to be found. The ratoon results appear in Tables V and VI of this report.

TABLE V.

Block F.—Ratoon Cane, 1915-16—*Planting Experiment.*

Variety.	Plot No.	Method of planting.	Plot area	Number of rows.	Width apart of rows.	Number of sets per acre.	Number of canes per row.	Weight of cane per row.	Weight of cane per acre.	Remarks.
1	2	3	4	5	6	7	8	9	10	11
			Acre		Ft.			lbs.	lbs.	
B 147	1	Ordinary Method ...	$\frac{1}{12}$th	5	4	6,552	296	1,051	63,048	
	2	Sets end to end ...	$\frac{1}{12}$th	5	4	8,196	276	978	58,680	
	3	Double row, ordinary...	$\frac{1}{12}$th	5	4	10,920	268	966	57,960	
	4	Double row, end to end.	$\frac{1}{12}$th	5	4	21,456	279	960	57,492	
	5	Ordinary Method ...	$\frac{1}{12}$th	4	5	5,460	291	1,156	55,476	
	6	Sets end to end ...	$\frac{1}{12}$th	4	5	7,332	310	1,238	59,412	
	7	Double row, ordinary	$\frac{1}{12}$th	4	5	8,736	321	1,288	61,848	
	8	Double row, end to end	$\frac{1}{12}$th	4	5	16,164	321	1,161	55,716	

TABLE VI.

Block F.—Ratoon Cane, 1915-16—*Planting Experiment.*

Variety.	Plot Number.	Method of planting.	Width apart of rows.	Weight of cane per acre.	Weight of juice per acre.	Juice on cane.	Cane sugar in juice.	Invert sugar in juice.	Total sugar in juice.	Glucose ratio.	Total solids in juice.	Purity co-efficient.	Total sugar in juice per acre.	Sugar in juice per acre.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			ft.	lbs.	lbs.	per cent.	per cent.	per cent.	Per cent.		per cent.		lbs.	lbs.	
B 147	1	Ordinary Method ...	4	63,048	37,608	59·65	15·48	0·75	16·23	4·84	17·5	88·5	6,104	5,822	These plots were badly lodged by storms just previous to harvest, many of the canes being broken off at ground level. This has no doubt increased the percentage of invert sugar in the juice at the expense of the cane sugar (sucrose), and also reduced the purity of the juice,
	2	Sets end to end	4	58,680	35,820	61·05	14·89	0·85	15·74	5·70	17·2	86·6	5,638	5,334	
	3	Double row, ordinary	4	57,960	35,448	61·16	14·84	0·84	15·68	5·66	16·9	87·8	5,559	5,261	
	4	Double row end to end	4	57,492	34,380	59·8	14·59	0·99	15·58	6·78	17·1	85·3	5,357	5,016	
	5	Ordinary Method ...	5	55,476	34,044	61·87	15·18	0·70	15·88	4·61	17·2	88·3	5,406	5,168	
	6	Sets end to end ...	5	59,412	35,976	60·55	14·91	0·83	15·74	5·56	17·1	87·2	5,663	5,364	
	7	Double row, ordinary	5	61,848	37,812	61·14	15·23	0·74	15·97	4·85	17·1	89·1	6,039	5,760	
	8	Double row end to end	5	55,716	33,240	59·66	15·29	0·80	16·09	5·23	17·6	86·9	5,349	5,083	

For reasons explained in the remarks column of Table VI, we do not propose to stress the figures for juice composition ; the experiment is most fairly judged we think on the figures for weight of cane per acre. Combining these figures with those for the plant cane of the previous year, we arrive at the following total yields of cane for the two successive crops :—

Plot 1	...	...	125,688	lbs. cane per acre.
„ 2	...	...	126,024	„ „ „ „
„ 3	...	...	120,288	„ „ „ „
„ 4	...	...	125,604	„ „ „ „
„ 5	...	...	103,788	„ „ „ „
„ 6	...	...	116,952	„ „ „ „
„ 7	...	...	124,680	„ „ „ „
„ 8	...	...	110,436	„ „ „ „

It will also be seen that the average ratoon cane production per acre for the 4-feet plots Nos. 1-4 is almost identical with that of the 5-feet plots Nos. 5-8, the numbers being 59,295 lbs. and 58,113 lbs., respectively. In the plant cane, however, the average was considerably greater in favour of the narrower rows.

Considering the two years' results together the conclusion one would draw from the figures is that something of the order of 6,500 to 8,500 sets per acre is the most economical rate for planting under our conditions and that it is a pure waste of material to plant more than this.

This agrees well with our previous experience, all of which has suggested that the optimum number of sets per acre is of the order 7,000 to 8,000.

In conformity again with previous results, wider planting between rows increases the tillering of the canes, and consequently the weight of cane per row, but taking the two crops together, *i.e.*, plant cane and ratoons, the advantage lies with the narrower planting in regard to total yield of cane per acre.

Sugarcane planting experiment.—Plant cane.

10. Commenced on Block B in 1915, this experiment was a duplicate of that laid down in Block F the previous year, the results of which are dealt with in the preceding paragraph.

Cane rows were 4 and 5 feet apart respectively, and different methods of planting were adopted, providing in the former case from 5,600 to 18,200 sets per acre and in the latter 4,600 to 15,000. Variety of cane used was B 147. Cultivation was the same as for the variety experiments plant cane in Block B.

Manuring was 30 maunds cake per acre, applied in 3 doses. The results will be found in Table VII. For reasons given in the remarks column, only the figures for weight of cane are available. The largest yields per acre for this the plant cane crop are again given by the narrower planting. In the case of the plots with rows 5 feet apart, about 8,000 sets per acre is again indicated as the optimum, while for the 4-feet rows about 10,000 sets per acre has given the most economical result.

This year the figures appear to indicate more clearly than in previous experiments, that not only the number of sets per acre but also their disposition may exert a considerable influence, *cf.* plots 2 and 3, where about 10,000 sets planted end to end in a single line gives some 10,000 lbs. cane per acre less than a similar number of sets planted in a double line, two feet apart from centre to centre of sets, in a somewhat wider trench.

TABLE VII.

Block B.—Plant Cane, 1915-16.—*Planting Experiment.*

Variety.	Plot number.	Method of planting.	Plot area.	Number of rows.	Width apart of rows.	Number of sets per acre.	Weight of cane per row.	Weight of cane per acre.	Remarks.
1	2	3	4	5	6	7	8	9	10
			Acre.		feet.		lbs.	lbs.	
B 147	1	Ordinary method	$\frac{1}{10}$th	5	4	5,630	1,060	50,300	The whole of this crop was very badly laid by severe storms about the 18th March 1916. Many canes were broken off, and the whole area was flattened out. This prevented any analytical work on the crop being done; accurate weighing of the crop was however possible and this was as much as could be done in the circumstances. No figures for composition of juice are therefore available.
	2	Sets end to end	$\frac{1}{10}$th	5	4	10,230	997	49,820	
	3	Double row, ordinary ...	$\frac{1}{10}$th	5	4	10,000	1,193	59,650	
	4	Double row, end to end ...	$\frac{1}{10}$th	5	4	18,230	1,201	60,060	
	5	Ordinary method	$\frac{1}{10}$th	4	5	4,600	1,030	41,200	
	6	Sets end to end	$\frac{1}{10}$th	4	5	8,220	1,169	46,740	
	7	Double row, ordinary ...	$\frac{1}{10}$th	4	5	8,650	1,343	53,720	
	8	Double row, end to end ...	$\frac{1}{10}$th	4	5	15,000	1,107	44,280	

Comparison of plots 6 and 7 reveals a similar state of affairs in regard to something of the order of 8,000 sets per acre disposed in the same two ways.

Should the final result, after harvesting the ratoon crop now on the ground, bear the above out, this is a matter which will bear further experiment.

Summary of results in planting experiments.

The following brief summary of some of the results obtained during the past few years from the planting experiments carried out is given :—

Working with distances between the rows of 3, 4 and 5 feet respectively, the spacing of the sets within the rows and hence the number of sets *per row* being the same (the distance between the rows and hence the number of sets *per acre* being the only varients), the following results have been obtained :—

(*a*) the greater the distance between the rows, the greater is the weight of cane produced *per row* for both the plant cane and ratoon crops ;

(*b*) the less the distance between the rows, the greater is the weight of cane *per acre* for the plant crop ; however in the case of the ratoon crop this is not so, the wider planting giving at least as big a ratoon crop, and in some years a bigger one than the narrower planting ;

(*c*) for the two crops, plant cane and ratoon combined, under our conditions of soil and manuring, and planting the sets 2 feet apart from centre to centre within the rows, the less the distance between the rows within the limits of 3 to 5 feet the greater the total yield of cane *per acre*;

(*d*) the number of sets within reason below about 10,000 sets per acre has little or no effect on the quality of the juice ;

(*e*) something of the order of 8,000 sets *per acre* seems to be about the optimum under our conditions.

New varieties of cane.

Two out of three varieties received from Barbadoes in 1914 did well, and are this year being tried on field plots.

Six more received in 1915 from the Imperial Sugar Expert were grown during the year, comprising Mauritius, Barbadoes and Java canes. Some showed good promise, *e.g.*, Red Sport of Striped Mauritius, Barbadoes 3,412 and Java 247 and 33*a*. They are being multiplied in the nursury with a view to being given field plots next year.

Soil investigation.

11. The earlier work described in previous reports* was continued as per schemes laid down at its inception. Commencing in 1909, it has been periodically extended to include the study of different aspects of soil treatment arising out of previous experiments, which have suggested themselves from time to time, and now comprises the following:—

Block G.—Liming experiment, commenced 1909.
,, C.—Liming and manurial experiment; also wood ashes experiment, commenced 1911.
,, K.—Experiments to ascertain the reasons underlying the remarkable effect of lime on the soil, laid down 1912.
,, L.—Ground lime stone experiment, started 1913.
Blocks B, E and A.—Experiments in the use of Stane's Flour Phosphate, commenced 1913, 1914 and 1915, respectively.

Block G.—Liming experiment.

12. Half of this block was limed, 50 maunds per acre, 7 years ago, and has not been re-limed since. Both sides have been regularly and similarly cropped twice a year ever since. The only crops which have matured on the unlimed side are cowpeas and *aus* paddy in the rains; it will carry no crop in the cold weather. The limed side has regularly produced a variety of crops, diminishing in outturn gradually as the time since liming increases. The cropping this year was *jowar* in the rains, and the usual crops, *matikalai*, oats, gram and mustard in the cold weather. The *jowar* germinated well all over the area but died out on the unlimed side within a very short time; the seedlings there grew to about 2 inches or so high, the leaves then turned reddish yellow before dying off. On examination it was found that the roots were blackened, shrivelled and dead; in many cases adventitious roots had formed, in an effort to continue the life of the plant after the death of the main root, and these later roots were sharing the same fate. These field observations agree exactly with those obtained in Laboratory tube cultures, using *jowar* seedlings in excessively dilute water solutions of the toxin extracted from this soil in 1912.

On the limed side, the *jowar* grew normally and none of the above root effects could be observed. The crop suffered much from heavy and continuous rain which made intercultivation impossible. It nevertheless matured a medium crop.

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* Annual reports of the Jorhat Experiment Station for the years ending June 30th, 1912, 1913, 1914 and 1915.

In the cold weather, the seedlings again died out very early on the unlimed side. On the limed side a small crop of oats matured, the other crops *matikalai*, gram and mustard, though making some growth, gave practically no grain at all. The gradual decrease in these crops on the limed side year by year, the decline being more rapid with some crops than others, is, we think, chiefly due to the re-establishment of sour soil conditions, and possibly to a much smaller extent to the factor of soil exhaustion. This latter factor is absent on the unlimed side, as the only crop it now matures at all is cowpeas, which is dug in for manure biennially.

Block C.—Liming and manurial experiment.

13. This experiment commenced in 1911 was continued in its 5th year, as per the scheme of manuring and rotation laid down.

The plots which had 10 maunds lime per acre in 1911, 1912, 1913 and 1914 were given a fifth dressing of 10 maunds per acre in the year under report, while the annual cross dressings of bonemeal and cowdung were applied to their respective plots as before.

The cropping during 1915-16 was :—

	Non-green manured block.		Green-manured block.
Rains ...	Maize	...	Cowpeas for green manure.
Cold weather	Oats	...	Oats.

Observations during growth.

Maize germinated all over, but better on the limed plots. All seedlings subsequently died out on the unlimed plots, even on those cross-dressed with bonemeal and cowdung, either together, or used separately. Of the limed plots, those receiving 10 maunds lime annually and 30 maunds triennially were throughout superior in growth to the plots dressed with 60 maunds lime once for all initially. The patchy appearance of individual sub-plots remarked on in previous reports, was evident in the maize crop this year also. The toxity of this soil appears to vary sharply from place to place within small areas. Our experience, considered in the light of recent work by Hutchinson at Pusa on the conditions favouring toxin formation in soils, suggests strongly that this state of affairs is due to slight differences of surface level ; after heavy falls of rain, the lower places are apt to lie more or less waterlogged for a time after rain ceases, which limits aeration, setting up such biological processes as result in the production of toxins. Though these toxins subsequently disappear more rapidly where lime has been used, liming apparently does not entirely prevent their formation when other conditions for such become very favourable. With better drainage the state of affairs should be materially improved.

The maize matured prematurely on account of constant heavy rain for 6 or 7 weeks following sowing, which made inter-cultivation impossible; weed competition was therefore severe. The crop carried cobs, which however, despite precautions, were badly attacked by crow and parrots.

Cowpeas on plots 5—8 grew well; the limed strips were the best, and the crop otherwise improved on the cross-dressed sections. It was hoed in for green manure about mid August.

Oats germinated well all over, but in the total absence of showers for a period of 10 weeks after sowing, development was poor, and the ultimate yield small all over. In the absence of lime, the crop died off young, but made a distinct struggle on those unlimed plots cross-dressed with bonemeal and cowdung. With lapse of time, the use of bonemeal and cowdung even in absence of lime, is undoubtedly producing better soil conditions, but the improvement is very very small and extremely slow.

The condition of the crop on the green-manured block was throughout much better than on the ungreen-manured area.

The results are given in Table VIII.

TABLE VIII.

Block C.—Maize, Cowpeas and Oats.—Fifth year of experiment.

Cross dressings.		Non-green manured block.									Green-manured block.							
		No lime.		Lime 50 maunds (10+10+10+10+10).		Lime 60 maunds (30+30).		Lime 60 maunds initially.			No lime.		Lime 50 maunds (10+10+10+10+10).		Lime 60 maunds (30+30).		Lime 60 maunds initially.	
		Plot 1.		Plot 2.		Plot 3.		Plot 4.			Plot 5.		Plot 6.		Plot 7.		Plot 8.	
1		2		3		4		5			6		7		8		9	
		Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.		Mds.	srs.	Mds.	srs.	Mds.	srs.	Mds.	srs.
Nil	M.	Nil		20	30	16	5	18	20	O.	Nil		5	0	5	10	4	10
	O.	Nil		2	18	3	5	3	5									
Bonemeal 3 maunds per acre annually in 1st to 5th years.	M.	Nil		14	20	26	5	14	20	O.	Nil		4	33	5	10	4	30
	O.	Nil		3	25	3	3	3	3									
Bonemeal 3 maunds and cowdung 100 maunds per acre annually in 1st to 5th years.	M.	Nil		25	20	16	20	16	15	O.	Nil		5	18	6	5	4	23
	O.	Nil		3	15	3	25	4	0									
Cowdung 100 maunds per acre annually in 1st to 5th years.	M.	Nil		28	0	22	15	19	35	O.	Nil		5	20	6	0	7	35
	O.	Nil		3	3	4	13	4	28									

All figures are per acre.
M. = Maize, whole crop.
O. = Oats, grain.
1 maund = 82 lbs.

Admittedly the crops were very poor, as the figures show; the season went entirely against us throughout both rains and cold weather; continuous rain fell from May to the end of July, and a long drought for 10 weeks followed the sowing of the oats in October. Weeds—the growth of which has been stimulated in a most extraordinary manner by the soil treatment given—gave much trouble. If any further testimony were necessary in favour of the great improvement in soil conditions following on the use of lime and bonemeal on this soil, it would be abundantly furnished by the luxuriance of weed growth which invariably follows their use, and by the change in the character of the herbage, coarse undesirable grasses giving place to finer and more nutritious ones. On small plots their eradication becomes very difficult, almost impossible—except by constant hand-weeding. Where labour is difficult as it is with us, the only solution of the difficulty is to have large plots upon which implements can be advantageously used. Knowledge of real value is however almost invariably that obtained by actual experience, and the lessons which these small plots have taught will be invaluable in our future experiments.

Lime dressings.

In regard to the differential lime applications, the evidence of the maize crop is, in this the 5th year of the experiment, strongly in favour of the smaller annual dressing, *cf.*, plots 2, 3 and 4, the relative crops being respectively as 140, 117, 100. This is not confirmed by the oats crop where plots 3 and 4 give a slightly greater yield than plot 2, the difference however being small and within the limits of experimental error. It is permissible however to infer that the yield from plot 2 is down by virtue of the exhaustion of the much bigger previous crop of maize which it carried.

The oats crop from the green-manured plots 5-8 likewise furnishes no evidence in the above sense, the maximum difference between these plots being less than 10 per cent., *i.e.*, within the limits of experimental error.

Last year it was remarked that the difference in crop yield as between the variously limed plots was becoming less marked as the experiment matures, as the plots which received recurring small doses of lime gradually approach in total amount to that used on those plots which received larger initial dressings.* The evidence this year leads one to suppose that the apparent superiority, as measured by the yield of the earlier crops of the heavier initial dressings, is gradually giving way in favour of the smaller recurring ones as the experiment matures.

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* For the original scheme of the experiment *vide* report for year ending June 30th, 1912.

Cross dressings.

In regard to the action of bonemeal the results (particularly those for the maize crop) are vitiated very largely by the severe competition of the crops with weeds which flourished especially on the bonemeal plots, and with which it was impossible to contend owing to the extraordinary climatic conditions of last year.

This has been remarked in previous reports especially in connection with the *jowar* crop. In last year's report doubt was expressed as to whether the reduction in the *jowar* crop following on the use of bonemeal was to be entirely explained by the extra element of weed competition thereby introduced.

Doubt as to this no longer exists; special plots were laid down to study this point and without digressing further they proved clearly that, providing the plots can be kept quite free of weeds, bonemeal exerts a distinct beneficial influence on the crop and leads to increased production.

Unless weeds can be kept down therefore the results obtained by the use of bonemeal on crops in general, more particularly such gross feeders as *jowar* and maize in the rains, are practically worthless, and as for reasons explained above the weeds absolutely got out of hand this year, I do not propose to discuss the bonemeal aspect any further, except to say that very special measures are now being taken to ensure the absence of weed competition, and up to the time of writing with apparent success.

Value of organic matter.

The evidence adduced last year in regard to the great role played by organic matter in these old alluvial soils is further strengthened by the present results. Thus the total yield of the oats crop for the green-manured block as against the non-green-manured block is expressed by the ratio 156 : 100.

It may be urged of course that the non-green-manured block had carried a previous crop of maize, and hence the lower outturn of oats. This is true, but it is all part of the scheme; against the extra crop obtained once in two years in the rains on the ungreen-manured block, when the other block is under cowpeas, must be set off the increased cropping which follows the biennial green-manuring of the other block.

In further emphasis of the value of organic matter the following figures are instructive :—

Relative yield of oats.	Cowdung plots.	Non-cowdung plots.
For whole area	122	100
Non-green-manured block separately ...	125	100
Green-manured block separately ...	121	100

Wood ashes experiment.

14. Commenced 1911. This is essentially a cultivator's experiment, designed to show that wood ashes will replace lime as a soil ameliorant, and that their conservation and regular use will considerably improve the cropping power of these old alluvial soils, having regard to outturn as well as the variety of crops which may be grown. There are five plots receiving per annum respectively 5, 10, *nil*, 15 and 20 maunds wood ashes per acre. Half of each plot is cross-dressed with cowdung at the rate of 100 maunds per acre per annum. In this the fifth year of the experiment, cowpeas for green-manure was the rains crop, followed by oats in the cold weather.

Cowpeas were dug in the middle of August and oats sown on 26th October.

Germination was good, but the seedlings died out early on the plot receiving no ashes.

The crop matured on the other plots. The yields were as follows :—

		Oats grain in lbs.
Plot 1.	5 maunds ashes per acre	nil.
	5 „ „ „ and cowdung ...	280
Plot 2.	10 „ „ „	126
	10 „ „ „ and cowdung ...	553
Plot 3.	Nil	nil.
	Cowdung	nil.
Plot 4.	15 maunds ashes per acre	95
	5 „ „ „ and cowdung ...	574
Plot 5.	20 maunds ashes per acre	360
	20 „ „ „ and cowdung ...	574

The plots are improving every year ; they have never matured such crops before ; in addition those plots receiving the larger dressings of ashes are now capable of carrying small to medium crops of *jowar*, a very exhausting crop.

The experiment is a success in that it proves that annual dressings of wood ashes, a thing which every cultivator produces regularly, will replace the more expensive lime as a soil ameliorant, and it is encouraging to be able to record that many rayots in the district are now conserving their ashes and applying them along with cowdung.

Block L—Ground limestone experiment.

15. Commenced 1913 on ground newly broken up from grazing land. The soil is very poor and infertile. The scheme consists of 6 plots of ⅓ acre each in two series of 3 plots; arranged thus :—

Road to farm buildings.

Section A (shallow cultivation)

Plot 1.	*Plot* 2.	*Plot* 3.
15 maunds limestone per acre equal to approximately 50 per cent. of the soil's lime requirements to depth 3-4 inches.	Limestone *nil.*	30 maunds limestone per acre equal to approximately 100 per cent. of the soil's lime requirements to depth 3-4 inches.
Plot 1.	*Plot* 2.	*Plot* 3.
15 maunds limestone per acre equal to approximately 25 per cent. of the soil's lime requirements to depth 6-8 inches.	Limestone *nil.*	30 maunds limestone per acre equal to approximately 50 per cent. of the soil's lime requirements to depth 6-8 inches.

Section B (deep cultivation).

Section A is always cultivated shallow with country implements, the other section B being cultivated more deeply with English implements. This ensures a deeper application of the limestone on section B than on section A, one of the chief objects of the experiment being to elucidate the effects of incorporating lime with the soil to varying depths, using a variety of cropping. Deep *versus* shallow cultivation also enters into the problem. During the first 2 years of this experiment the cropping was cowpeas for green-manure in the rains followed by oats in the cold weather. The results for oats, a shallow rooting crop, were rather better on section A than on section B. (*See* last year's report for discussion of this aspect.)

This year it was decided to use deeper rooting crops. Accordingly a mixed crop of maize and *arhar* was sown in the spring on all plots. It was intended to harvest the maize and carry the *arhar* on through the cold weather for seed. However, as only one plot (section B, plot 3) carried a crop worthy of the name the crops were cut and weighed green about the middle of August. Wheat was taken in the cold weather.

Observations during growth. Maize and *arhar*.

From the first, Section B, deep cultivation, took the lead and held it easily. On either section, the limed plots soon showed a clear advantage over the unlimed. Sown on the 27th April, the maize seedlings on the unlimed plots were yellowish in colour and moribund a fortnight later. At this time the *arhar* did not seem to be so much affected by lack of lime as maize; however the 30 maunds limestone plots were clearly better and more forward than the 15 maunds plots.

Again, a note made three weeks later (June 7th) shows that by that time the maize had entirely died out on both unlimed plots; the *arhar* however was struggling though some plants had died out.

On the 15 maunds limestone plots the maize was still holding out particularly on the deep cultivated section, but already it looked as if it would go out completely on these plots.

The *arhar* was doing better everywhere, but already it looked as if ultimately the crop would not carry through except on the 30 maunds limestone plots.

Six weeks later (July 24th) section A, plot 3, and section B, plot 1, were carrying a few straggling and struggling *arhar* plants here and there. At this time the only plot carrying a real crop was section B, plot 3, *i.e.*, 30 maunds limestone and deep cultivation. Elsewhere over the whole area there was very little remaining of either crop.

The cropping figures appear in table IX.

TABLE IX.

Block L.—Ground Limestone experiment—Figures are per acre.

Plot.	Treatment.	Section A (shallow).		Section B (deep).		Remarks.
		Maize and *arhar* cut and weighed green in August.	Wheat (grain).	*Maize* and *arhar* cut and weighed green in August.	Wheat (grain).	
1	2	3	4	5	6	7
		lbs.	lbs.	lbs.	lbs.	Section A is cultivated only 3 to 4 inches deep. Section B is cultivated some 6 to 8 inches deep.
1	15 maunds limestone.	60 (No maize, all *arhar*).	6	366 (No maize, all *arhar*).	2	
2	Nil.	42 (No maize, all *arhar*).	Nil.	96 (No maize, all *arhar*).	Nil.	
3	30 maunds limestone.	294 Maize ... 75 *Arhar* ... 219 Total ... 294	163	1,458 Maize ... 552 *Arhar* ... 906 Total ... 1,458	114	

These provide a very interesting comparison with results during the previous two years for oats.

This crop, oats, had done better on section A, shallow cultivation. The opinion was expressed in last year's report that the results of this experiment might be expected to vary from year to year with the nature of the crop grown, *i.e.*, whether shallow or deep-rooting and again whether more or less tolerant of soil acidity These results bear out very emphatically that opinion and prove that in considering the extent of lime applications regard must be had amongst other points to the depth to which it is desirable to incorporate it, bearing in mind the nature of the cropping.

The wheat crop was a very poor one as the figures show ; this is not a wheat soil, tillering was very poor indeed and the season was adverse. The crop was grown chiefly as being a deep-rooter. The figures are nevertheless instructive.

It will be seen that maize and *arhar* have both done much the best on section B, deep cultivation. On the other hand, wheat agrees with the indications of the previous oats crops and did better on section A, shallow cultivation.

Arhar, wheat and maize are all more or less deep-rooters, at any rate they all normally root much deeper than oats.

To what other factor then shall we attribute the apparently contradictory results of the maize and *arhar* as against wheat? It is tentatively advanced that the operating factor will be found in the differing capacity of crops to withstand acidity more especially perhaps during the early growing period. Maize and *arhar* may be seen doing well on soils in Assam which are sour (but do not therefore necessarily harbour specific plant toxins as ours does).

Deeper cultivation, and the deeper incorporation of the lime which necessarily follows, would therefore appear to influence crops like *arhar* and maize more favourably than such a crop as oats and perhaps wheat, provided that sufficient lime be used to break up the soil toxins where present.

Wheat would appear to be more susceptible to acidity than either *arhar* and maize, *cf.* the results of plots 3A and 3B, the soil of the former having been neutralised to the extent of 100 per cent. of its lime requirements initially, the latter only to the extent of 50 per cent. thereof. This is probably more particularly true in the early stages of the crop, as plot observations during the first few weeks of growth show that section A grew faster and looked much darker green and healthy than section B at a time when its root system must have been confined to the first few inches of soil.

The results clearly show, at any rate, that for certain cropping, using a given quantity of lime per acre, it will pay to incorporate it more deeply than for other crops, for which the converse appears at present to be true. Further, in the case of any particular crop, there would appear to be more than the factor of root depth to be considered. The relative immunity of the crop to the effects of soil acidity, and where present of soil toxins, must be carefully determined, particularly perhaps in regard to the early stages of the crop's life.

Arhar appears to be much more tolerant of soil acidity than wheat or even maize and for this crop it will pay to incorporate lime deeply. From the table it will be seen that even the unlimed plots of both sections A and B carried through small crops of *arhar*, and that the effect of deep cultivation alone, in the absence of lime, was to more than double the crop. When lime was used in addition however, the effect was to considerably raise the relative proportions between the crops of corresponding plots of the deep-cultivated and shallow-cultivated sections.

Arhar apparently does no demand that the lime requirements of the soil should be so fully satisfied as is necessary for certain other crops, *e.g.*, oats, wheat and maize. It would appear to belong to that class of crops which, on account of deep rooting habits and a comparative tolerance to acidity, would respond quite well to moderate doses of lime worked well down into the soil. Nevertheless within the limits prescribed by this particular experiment, the more completely the lime requirements of the soil are satisfied the better the growth and development of the crop, and this applies, again within the limits of our experiment, either for shallow or deep cultivation.

The results are exceedingly interesting and suggestive and open up a wide field for further enquiry.

Block K—experiment to ascertain the early functions of lime.

16. An experiment was commenced in 1912, the chief object being to ascertain the reason or reasons underlying the remarkable effect of lime on this soil. Reference may be made to page 24 of the report of this farm for year ending 30th June 1913, and for the results of the first two years of this experiment to No. 9, Volume III, Chemical Series of the Memoirs of the Department of Agriculture in India entitled "Studies of an Acid Soil in Assam." This experiment has been continued, and in some respects extended to include the study of problems arising out of earlier results. The original experiment is thus now in its fifth year, and reference to some very interesting observations recently made with regard to the effect of the continued application of certain artificials may be permitted perhaps :—

(*a*) The favourable effect of such bases (or neutralisers of acidity) as lime, the Carbonates of lime, Potash, Soda, Magnesia, etc., continues to be strongly marked.

(*b*) Though small initial dressings of superphosphate were beneficial, the continued application of this fertiliser in the absence of lime appears to be detrimental on this soil.

(*c*) The value of phosphoric acid in a basic form however, *e.g.* Basic Slag, and certain raw mineral phosphates [*vide* (*g*) below] continues to be evident, leading to increased crop production and earlier ripening.

(*d*) The toxic effect of sulphate of ammonia in the absence of lime, and more especially when used in the absence of other artificials is very pronounced. The sulphate of ammonia plot now absolutely refuses to grow a single weed or crops of any description in the cold weather, and even in the rains when weeds are such a pest on this farm very few indeed survive.

(*e*) The above toxic effect of sulphate of ammonia is somewhat marked when used along with other artificials, especially if superphosphate is a constituent. In view of what is said in (*b*) prepage, this seems rather remarkable. A note on this aspect will be found at the end of this paragraph.

(*f*) The unfavourable effect of the continued use of sulphate of ammonia as against nitrate of soda is now, with lapse of time since the lime was applied, becoming evident even where used on the limed sub-plots.

(*g*) The experiment proves the lasting value of certain raw mineral phosphates on this soil, *e.g.*, Stane's Flour Phosphate, raw Egyptian phosphate, though showing up clearly the unavailability of the phosphoric acid contained in other minerals notably apatite, which appears to be almost useless.

(*h*) Sulphate or muriate of potash and also nitrogen applied to the cold weather crops as nitrates appear to have very little effect when used alone or together; however, when used with superphosphate they produce an additive effect.

With reference to (*e*) above, it was very marked this year during the rains, crop cowpeas, that of the unlimed plots, that plot receiving both superphosphate and sulphate of ammonia was clearly better throughout and returned a bigger crop finally than either of the plots dressed with these two manures separately. The latter two plots, Nos. 10 and 11, respectively, were inferior to the no manure plot No. 4, while plot 23 getting both superphosphate and sulphate of ammonia together was better even than 4. The question may be asked if the continued use of either of these two manures alone is up-to-date rather detrimental, by reason presumably of their acid character, why when used together does their combined effect, become a positive one and lead to increased production? It seems to point to the fact that, within limits at any rate, the ability of the plant to withstand soil acidity and make growth is *directly* dependent not only on the amount but also on the variety of available plant food present in the soil, *i.e.*, within limits which have yet to be determined by further continued use of these acid manures, the more completely the requirements of the plant for food are supplied, even at the expense of increasing the acidity thereby, the better will be the development, that is to say, the crop will do better than where the acidity may be slightly less but the available plant food is more one sided in character. On these grounds alone therefore on very poor soils which are moreover sour, the correct procedure would appear to be not only to use some lime, but in addition more or less complete mixtures of plant foods, preferably in a basic form.

Results obtained with the previous cold weather crop of oats point to a similar state of affairs existing in regard to that crop also, though in this case with a given amount and variety of plant foods present, the limit of acidity for oats is much lower than that for cowpeas.

The amount of acidity a crop can stand then appears to be not merely a function of the variety of the crop itself; it also seems to depend on the amount and variety of the available plant foods presented to the roots of the crop.

Blocks E, B, and A.—Flour Phosphate Experiments in the Sugarcane rotation.

17. Parts of these three blocks, which regularly come under sugarcane two years out of four, have been dressed with flour phosphate with a view to observing its effect on the various crops of the rotation.

The flour phosphate was applied before the sowing of the green-crop of cowpeas in the 4th and last year of the rotation in each case. Its application will be repeated every 4th year at the same point in the rotation.

The immediately succeeding crop of cowpeas benefits somewhat from the phosphate, and should by its rapid decomposition after turning into the soil tend to render available the phosphate for succeeding crops.

The crop is ready for hoeing in a week or 10 days before that on the unphosphated land.

As each rotation takes four years to work out, and there are 4 blocks under the cane rotation, this experiment commenced in 1913, cannot be expected to afford much information as yet. The results to date point to the fact that while the phosphoric acid of this particular phosphate is immediately available to certain crops, *e.g.*, mustard, its full effects on other cropping cannot be expected so very early. Its effect on the plant and ratoon cane crops in the 1st and 2nd years following its application have been discussed in previous paragraphs of this report (paragraphs 7 and 8).

This year, the third after application on Block E, the benefit to a green crop of *dhaincha* was very marked indeed, the crop being ready for ploughing in fully a fortnight before that on the un-phosphated area.

Block A was the area to receive the Stane's Phosphate this year, one acre being treated out of two. Mustard was taken as the cold weather crop, following cowpeas ploughed in, and made a 16 annas crop on the phosphated area, while a few scattered plants only survived on the untreated part. Contrary to the practice of previous years, the mustard was not brought to harvest, but ploughed in while flowering in the middle of November. The practice of taking to harvest a *rabi* crop immediately before planting cane is one that cannot be recommended; however if it be ploughed in green by mid November, a crop of mustard should not only tend to prevent loss of nitrates, but also liberate for the ensuing cane crop a supply of available phosphoric acid. As the mustard is ploughed in very early, and cane planting can usually not be done before the end of February at the earliest here, a cold weather fallow in the rough is still possible, and on the above grounds this procedure seems quite unobjectionable. The plant cane crop now growing up on Block A seems to bear out the above so far.

Extension area.

18. *Block M.*—This was under cowpeas for green-manure. This block which is difficult of drainage suffered badly in this year of excessive rainfall; the limed side produced a fair crop, the unlimed area being very patchy and poor. This block has since been specially drained after the system of Howard at Pusa, with the further object of levelling the area up and bringing it into a fit condition for experiments. *Matikalai* was taken on this block as the *rabi* crop. The outturn was poor, this being newly-reclaimed land and very infertile, the limed acre yielding 2 maunds 7 seers grain, the unlimed acre producing no seed whatever.

Blocks O and R.—Plant cane for distribution. B 147, B 376 and Striped Mauritius were planted, and did well, and provided much excellent planting material. Upwards of 92,000 cane sets of these varieties were distributed this year from the Jorhat Farm.

Other crops.

19. *Block D*—Was under maize after ratoon cane. The climatic conditions made inter-cultivation impossible; the crop was only medium and was cut green and fed to the cattle. *Matikalai* was the cold weather crop; it was sown too thin on a very dirty seed bed, with the result that the crop was very weedy. In order to cleanse the land, it was considered better to plough up the crop and cultivate during the dry months.

Block H.—*Buri* and Combodia cotton were again tried. The abnormal season proved quite disastrous to both.

Cowpeas for seed.—Most of Block H was devoted to an attempt to ascertain the most favourable season for sowing cowpeas for seed production hereabouts. This had proved a difficult matter on this farm, as though this crop makes such splendid vagetative growth in the rains, it usually fails to mature seed by reason of insect attacks in the early autumn. Cowpeas here also produce very little seed as a cold weather crop.

Successive sowings were accordingly made from May to October at intervals of about 3 weeks. The sowings made on the 10th August and early September made the best seed crop, the former giving 3¾ maunds per acre, the latter only 2¼ maunds. Our experience thus points to sowings made in the first half of August as likely to give most seed, and the seed should be sown in drills 2-2½ feet apart, thinning out the plants to 18 inches to 2 feet apart in the rows subsequently. About 10 lbs. of seed per acre should suffice. This should give a larger outturn than was obtained by us this year, as our drills were 3 feet apart, which observation suggested could be advantageously reduced to 2-2½ feet.

Kitchen garden.—This was used in the rains to grow a variety of green-crops, etc., for observation, comparison and selection, *e.g.*, cowpeas (varieties) ; soy-beans (varieties) ; Java Natal Indigo, ground nuts (varieties) ; velvet beans, sword-beans, etc.

Cowpeas.—Five varieties were grown ; most of them make very rank vegetative growth in the rains, and all produce vines then. Differences are however noticeable throughout the growing period in both respects. One variety (Jorhat Brown) has now been isolated, which, within the first 6 weeks following sowing, makes considerably more bulk as a green-crop than the others. It is also a week later in commencing to throw out vines.

The five varieties were grown in beds 6′ × 130′ under identical conditions ; the yields of green matter after 7 weeks' growth were as follows :—

(*a*) Jorhat Brown	...	570 lbs.	=	14·2	tons	per	acre.
(*b*) Meeler	...	524	„	= 13·0	„	„	„
(*c*) New Era	...	512	„	= 12·8	„	„	„
(*d*) Dibrugarh seed (*ex*-Bihar)	...	510	„	= 12·7	„	„	„
(*e*) Brown Eye	...	348	„	= 8·7	„	„	„

" Jorhat Brown " and " Meeler " had only just commenced to throw out vines, while the Dibrugarh variety had at this time vines about 3 feet in length. It is gratifying to us to note how widely cowpeas are at length being taken up on surrounding tea estates as a green-crop, the more so perhaps as slow conversions generally inspire the more confidence.

The "Jorhat Brown" is so far clearly the best variety of cowpea we have experimented with; in addition to its clear lead over the others as a quick producer of a bulky green crop, it also seeds much more freely if sown at the proper season. It is hoped it may be possible to make arrangements to have this variety widely grown for seed in which case it should become increasingly available on the market.

Java Natal Indigo did well, though much too slow here as a green-crop, and produced a large quantity of seed harvested in March; a small plot 780 square feet in area gave 15½ seers seed, or at the rate of over 20 maunds seed per acre.

Soybeans.—The Shillong soybeans gave 15 maunds seed per acre, as against 11¾ maunds for the farm variety. The soybean is also with us much too slow as a green crop, and apt to become woody.

Ground nuts.—Four varieties were grown on plots of 780 square feet area. Yields as follows:—

Raipur	...	...	...	23	maunds	per	acre.
Virginia	...	...	...	20¾	"	"	"
Big Japan	...	...	...	18¼	"	"	"
Farm Seed	...	...	...	16	"	"	"

20. Fruit trees comprise 16 Lichis, 3 Lengra Mangoes, 3 Fazli and 2 Raspur mangoes, one custard apple, 3 sepota, 5 guavas, 1 pomelo and one plum. In addition some 600 pineapples of the Ceylon, Spanish, Queen and Akbarpur varieties are planted. The Lichis are all Muzaffarpur, except one which is a Chinese variety. They all fruited well, the fruit being sold locally. The Lichi trees are layered yearly, and a number of layers are sold.

Fruit.

The mangoes flowered as usual but bore no fruit.

The custard apple, sepotas and guavas all fruited, but most of the fruit was destroyed before ripening by bats and birds.

The pomelo fruited for the first time, as also the plum.

The pineapples fruited very freely and were disposed of in the bazar. About 200 suckers of the Ceylon variety were sold locally.

Receipts and Expenditure.

21. The receipts from sale-proceeds amounted to Rs. 2,725-14-3. The total expenditure including cost of establishment and charges on capital account amounted to Rs. 9,063-12-2.

Establishment.

22. This consists of a Farm Superintendent on Rs. 100-10-200, Clerk on Rs. 25—1/8—40 and a peon Rs. 8. The number of Apprentices on the Farm during the year was six.

Two completed their training,—Anandi Ram Gohain and Devendra Nath Hazarika, and were appointed temporary Demonstrators from 5th April 1916.

The following new Apprentices were appointed during the year, Bogairam Bora and Bideshiram Dutta.

Srijut Binaram Das continued to hold the post of Farm Superintendent throughout the year.

Munshi Mohsen Ali was appointed Fieldman Clerk in June 1915, vacating this post in June 1916, when he left to join the Bihar Agricultural College as a Government Scholar. In his place Srijut Kanthiram Gogoi was appointed as clerk from the 15th June 1916, the post of Fieldman Clerk having been abolished.

Inspection.

23. The Director of Land Records and Agriculture inspected the Farm twice during the year. The Acting Deputy Director of Agriculture being in residence at Jorhat, was in constant touch with the Farm, throughout the year.

The following gentlemen visited the Farm during the year :—

Dr. Mullins, Civil Surgeon, Sibsagar.

Mr. G. R. O. Simpson, Gatoonga Tea Estate.

Mr. S. J. Best, Octavins Steel and Company, Calcutta.

Mr. L. A. Chapman, Panitola, Dibrugarh.

Messrs. Hope, Tunstall, and Cooper, Indian Tea Association, Scientific Department.

Messrs. Ghosh and Mookerjee of the Civil Veterinary Department.

Muhammed Abdul Latif K. S. of Manikarchar, Dhubri.

A. A. MEGGITT,
Acting Deputy Director of Agriculture,
Assam Valley.

JORHAT :
The 13*th August* 1916.

ANNUAL REPORT OF THE UPPER SHILLONG AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING THE 30TH JUNE 1916.

History and description.

The Upper Shillong Agricultural Station was established in 1897-98. It is situated on the Cherrapunjee road, 5½ miles from the town of Shillong, and occupies the site of the old Model Farm which ceased to exist in 1879. The elevation of the place is 5,900 feet, *i.e.*, about 900 feet higher than Shillong town. The total area of the farm is 366·67 acres, of which a large portion is occupied by pine forest. Most of the cultivated and culturable land lies in a long narrow valley. The bottom of the valley was formerly a marsh which was of very little value for any purpose, it has recently been converted into firm pasture ground by deepening the stream which drains the valley and opening side drains into it. The effect of this work is now showing in the considerably improved herbage which is produced.

The soil of the higher lands is a coarse reddish loam of very loose texture which can be worked with great ease. The subsoil is of a very pronounced reddish colour and of great depth. In a small portion of the cultivated area the soil is black owing, it is believed, to the existence of some mineral compound. At the bottom of the valley, a different type of soil is found, namely, clay or clayey loam, extremely rich in organic matter. Having long been under a thick growth of grass, the upper portion of this soil is a matted mass of half decayed grass-roots.

In point of quality the soil of the farm is extremely poor, and very little can be grown on it without the help of manure.

The greater part of the station suffers from the disadvantages of an exposed situation. The place is colder and more windy than Shillong; frosts are of very common occurrence and are more severe than in the town. During the winter, the growth of vegetation is entirely suspended.

Purposes of the station.

2. The main objects for which the station is maintained are the trial and introduction of new varieties of potatoes which are the most important among the crops grown on the plateau of the Khasi Hills, the breeding of improved strains of milch cattle suitable for this tract and the cultivation of fodder crops for their upkeep. Fodder experiments have been tried from time to time,

but having proved abortive, they have one after another dropped out of the programme of the farm. Very little experimental work beyond the potato trials is done at present on the farm, and if we leave out the cattle and the fodder crops grown for them, the station may be looked upon more as a seed-growing farm than one devoted to experimental work.

Weather.

3 The following table gives the rainfall during the official agricultural year under report:—

Rainfall.

—	Actual, 1915-16.	Normal.	Number of rainy days, 1915-16.
1	2	3	4
1915.			
July	23·30	17·75	27
August	21·13	15·67	21
September	7·64	11·06	16
October	6·67	7·55	11
November	1·02	1·27	5
December	...	0·18	...
Total for six months	59·78	53·48	80
1916.			
January	0·03	0·29	...
February	0·56	1·02	2
March	0·17	2·25	1
April	7·58	4·48	15
May	5·94	8·83	13
June	11·84	20·04	21
Total for six months ...	26·12	36·91	52
Total for year	85·90	90·39	132

These 12 months really cover parts of two different agricultural seasons, as on the plateau of the higher Khasi Hills the cropping season commences in February and ends in November.

The light autumn rainfall was favourable for hay making and for the late potato crop. The rainfall of February and March was short and in consequence the early sown crops received a severe check at the commencement of their growth from which they did not completely recover. Although the rainfall of April was ample, it did not set in sufficiently soon to undo the injurious effects of the earlier shortage.

Except for the potato crop which is yielding well, most of the other crops will give a smaller return than the normal. The maize crop is a moderate one, Job's tears and Raishan (paspalum sanguinale) are poor, and owing to the early check in growth caused by the drought the upland rice is very light also.

Summary of work.

4. The work done during the year included :—

(1) Trials of different varieties of potatoes,
(2) Growing potatoes for seed,
(3) An experiment in warping of rice land,
(4) Trials of new crops,
(5) Fodder crops,
(6) Cattle breeding,
(7) Sheep breeding,
(8) Distribution of seeds, implements, etc.

Trial of varieties of potatoes.

5. In addition to the 13 varieties tried in the previous year (1915), nine varieties which were obtained from Messrs. Sutton and Sons in 1915 and which were grown as an autumn crop were included in the experiment. Three of the freshly imported lots were varieties which had already been grown for some years and the remaining lots were new to the district. The newly imported varieties were Magnum Bonum, Up-to-date, Windsor Castle, Stirling Castle, Epicure, Edinburgh Castle, Dover Castle, Balmoral Castle and Acquisition. The total number under this experiment was thus 22 varieties. Where it was possible each variety was planted in duplicate plots of $\frac{1}{40}$th of an acre each. All the varieties were planted in March and harvested in August. Winter seed was used in each case. The land was manured with 300 maunds of cowdung and 10 maunds of rape cake per acre, and the crop was sprayed with Bordeaux mixture at the rate of 240 gallons per acre, applied in two equal doses.

The outturns of each variety in 1916 and in previous years are exhibited in the following table :—

Statement showing the average yield per acre on duplicate plots for the last nine years.

Variety.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	Average of last five years.	Average of last nine years.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13
	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	Md. sr.	
1. King of Potatoes	250 30	172 20	217 35	186 20	234 0	201 0	131 20	95 30	319 0	212 13	200 39	
2. Magnum Bonum (1908)	252 10	184 20	214 0	165 20	232 0	160 35	132 20	87 30	277 0	200 26	189 24	
3. King Edward VII	200 10	125 25	168 5	133 20	128 20	163 13	78 20	90 15	269 0	151 8	150 33	
4. Khasi Nainital	227 35	148 0	189 0	174 10	166 20	157 30	119 0	111 30	293 0	183 5	177 14	
5. Khasi Round	160 20	135 30	123 8	123 0	111 20	135 2	92 25	102 25	255 0	130 32	138 1	
6. Windsor Castle (1909)	225 30	164 0	209 35	158 20	205 0	181 15	63 15	...	...	192 25	...	
7. British Queen („)	248 20	200 30	196 5	152 30	181 20	189 35	92 30	...	...	195 37	...	
8. Up-to-date	265 30	166 30	207 25	186 20	178 0	153 0	90 0	...	...	200 37	...	
9. Magnum Bonum (1912)	243 0	134 20	170 10	156 0	224 0	...	...	...	...	185 22	...	
10. Windsor Castle („)	275 30	169 0	238 20	129 0	196 0	...	...	...	...	201 26	...	
11. British Queen („)	216 30	168 30	181 20	142 20	72 20	...	...	...	...	156 14	...	

12. Flour Ball	123 30	134 30	142 10	160 30	173 0	...	...	...	...	146 36	...
13. Imperator	214 10	186 20	183 15	167 20	211 0	...	...	...	...	192 21	...
14. Magnum Bonum (1915)	64 0	...	...	...	...	...	...	...	...	...	...
15. Up-to-date (,,)	59 0	...	...	...	...	...	...	...	...	...	...
16. Windsor Castle (,,)	46 20	...	...	...	...	...	...	...	...	...	...
17. Stirling Castle (,,)	70 10	...	...	...	...	...	...	...	...	...	...
18. Epicure (,,)	128 20	...	...	...	...	...	...	...	...	...	...
19. Edinburgh Castle (,,)	76 18	...	...	...	...	...	...	...	...	...	...
20. Dover Castle (,,)	92 10	...	...	...	...	...	...	...	...	...	...
21. Balmoral Castle (,,)	64 30	...	...	...	...	...	...	...	...	...	...
22. Acquisition (,,)	35 0	...	...	...	...	...	...	...	...	...	...

This was the second season for the new varieties, and as usually happens, they have not given a very heavy yield during their first two seasons. However as the seed has now become acclimatized, results more in agreement with those obtained from the older varieties may be expected in future. Epicure, with 123 maunds per acre, has given the heaviest outturn of the nine new lots. Of the thirteen older varieties, Windsor Castle has, this year, given the largest crop, Up-to-date, King of Potatoes and British Queen being very little behind. From the average yields given by these four varieties during the past five years there would seem to be little to choose between them with regard to their cropping powers.

As in former years, 50 tubers of each variety were selected at random, cut open and examined for signs of disease. The following table gives the results of the examination in the last seven years :—

Varieties.	Number of diseased tubers out of 50 examined.						
	1910.	1911.	1912.	1913.	1914.	1915.	1916.
1	2	3	4	5	6	7	8
King of Potatoes*	12	Nil	Nil	Nil	1	5	3
Magnum Bonum (1908)	6	4	2	4	2	Nil	1
King Edward VII (1906)	18	8	4	6	5	4	1
Khasi Nainital (1908)	48	16	8	4	4	8	Nil
Khasi Round (1900)	4	8	6	10	6	6	10
Windsor Castle (1909)	...	...	4	3	3	12	2
British Queen (1909)	12	Nil	6	4	2	8	2
Up-to-date (1909)	4	32	16	4	1	6	4
Magnum Bonum (1912)	...	...	6	6	2	2	1
Windsor Castle (1912)	...	...	4	3	2	10	1
British Queen (1912)	...	...	4	4	3	6	1
Flour Ball (1912)	...	...	6	3	1	10	1

*Figures for 1910-11 are for the old stock of King of Potatoes imported in 1906, while those for 1912—15 are the new stock which was imported in 1912.

Varieties.	Number of diseased tubers out of 50 examined.						
	1910.	1911.	1912.	1913.	1914.	1915.	1916.
1	2	3	4	5	6	7	8
Imperator (1912)	...	...	22	3	3	4	6
Stirling Castle (1915)	...	...	...	...	...	...	10
Epicure (1915)	...	...	...	...	...	...	5
Magnum Bonum (1915)	...	...	...	...	...	...	5
Dover Castle (1915)	...	...	...	...	...	...	4
Up-to-date (1915)	...	...	...	...	...	...	1
Windsor Castle (1915)	...	...	...	...	...	...	2
Edinburgh Castle (1915)	...	...	...	...	...	...	3
Balmoral Castle (1915)	...	...	...	...	...	...	5

Potato disease, caused by *Phytophthora infestans*, is responsible for considerable damage to the crop in the Khasi Hills in some seasons. Preventive spraying is as thoroughly and systematically carried out on the farm every year as weather conditions permit, and as a result this year's potato crop was a good one and well over the average both for yield and freedom from disease.

During the year, three new varieties were obtained from England, *viz.*, Arran Chief, King Edward VII, and King of Potatoes.

Twelve seers of seed potatoes of the variety Arran Chief were obtained from Messrs. Sutton and Sons. Half of the seed was sent to the Karimganj Farm to be planted in November, grown as a cold-weather crop, and the produce to be returned as seed to Shillong. From this quantity about twenty seers of seed were returned and planted on the farm in the middle of April. The remaining half of the original seed, that is, 6 seers, was planted on the farm early in March.

The crops obtained were 22 seers from the 30 seers of Karimganj Farm grown seed, and 33 seers from the 6 seers of imported seed. This indicates that the change of seed from Karimganj with its widely different climatic and other conditions is far from being a suitable one. A few tubers of the variety King Edward VII were obtained from Messrs. Sutton and Sons and planted early in

March. The produce of these will be tried further next year. This lot is styled King Edward VII of 1916 to distinguish it from King Edward VII imported in 1906.

About twelve seers of the variety, King of Potatoes, were obtained from Messrs. J. K. King and Sons, Coggeshall, Essex, England. These potatoes were planted in the middle of April and gave an outturn of 2 maunds 10 seers. This variety will be known as King of Potatoes, 1916, to distinguish it from King of Potatoes imported in 1912

The seven new types of potatoes bred at the farm in 1914, from seeds of the variety Flour-ball and grown since that time, were planted again in a bigger area of about $\frac{1}{10}$th acre in the spring of 1916. Their respective yields are as follows :—

——	Area.	Quantity planted.	Actual yield.	Yield per acre.
1	2	3	4	5
	Acre.	Seers.	Mds. srs.	Mds. srs.
Type I	$\frac{1}{80}$	5	1 39	158 0
„ II	$\frac{1}{80}$	5	1 1	82 0
„ III	$\frac{3}{160}$	5	2 2	109 14
„ IV	$\frac{1}{80}$	4½	1 7	94 0
„ V	$\frac{1}{40}$	10	3 35	155 0
„ VI	$\frac{1}{80}$	5½	1 20½	121 0
„ VII	$\frac{1}{160}$	3½	0 22	88 0

The plots were manured with cowdung at 300 maunds and Rape cake at 10 maunds per acre.

Although a certain amount of selection work has been done with these types, they do not yet seem to be pure. They have been further selected this year and it is proposed to test them on a field scale next season.

Potato seeds from St. Andrew's University.

Twenty lots of seed were obtained, in February 1916, from St. Andrew's University, through the kindness of Mr. Donald Ferguson of Dhamai Tea Estate, Sylhet, Honorary Correspondent of the Department. Half of each lot of seed was sown in boxes on 20th February 1916, and the remaining half was sown similarly on 19th March 1916. Out of the twenty lots numbers four and twenty failed to germinate. The others grew satisfactorily, and the seedlings were planted in the field on the 15th May.

Two lots of seed produced only one plant each, and as one of these plants failed to form any tubers, the total number was reduced to nineteen. The nineteen lots gave widely varying yields, and the potatoes obtained from them are being held over for further trial. As seedling potatoes generally require to be grown for two or three seasons before they give anything like their full yield, little information can be expected until these have been grown for at least another year.

Potato manurial experiment.—An experiment designed to shed some light on the respective manurial values of Rape Cake and Bonemeal for the potato crop was arranged in duplicate on a series of plots of King of Potatoes, and a similar duplicate experiment was carried out with Magnum Bonum. The seed rate was 12 maunds per acre. The manures used and the yields obtained are shown in the accompanying table :—

Manures used per acre.	Cowdung 150 mds.	Cowdung 150 maunds, Rape Cake 10 maunds.	Rape Cake 10 maunds.	Bonemeal 10 maunds.	Cowdung 150 maunds, Bonemeal 10 maunds.
1	2	3	4	5	6
			Yields per acre.		
	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.
King of Potatoes ...	152 20	207 0	78 20	128 0	180 0
King of Potatoes ...	129 20	194 0	81 0	117 0	196 0
Magnum Bonum ...	106 20	159 20	73 0	118 0	152 20
Magnum Bonum ...	108 20	198 0	78 0	130 20	165 0
Total ...	497 0	758 20	310 20	493 20	693 20
Average yield per acre ...	124 10	189 25	77 25	123 15	173 15

Bonemeal and Rape Cake were used, not because they were considered the most suitable for the potato crop, but because they are practically the only manures, other than cowdung, which are known to the cultivators of the Khasi Hills.

From the yields obtained it would seem that, under the conditions prevailing on the Upper Shillong Farm, while Rape Cake is more effective than Bonemeal as a supplementary dressing with cowdung, yet when used alone the Bonemeal gives much better results than the Rape Cake.

Potatoes for seed.

6. Six varieties of potatoes were grown during the year for the purpose of seed, namely, King of Potatoes, Magnum Bonum, Up-to-date, Windsor Castle, British Queen and Imperator. The crop was planted in March. The total area planted was 3·175 acres as against 8·975 acres in 1915. The manures used were, as in previous years, 150 maunds of cowdung and 10 maunds of Rape Cake per acre and the crop was sprayed twice as usual, with Bordeaux mixture at the rate of 120 gallons each time. The outturn was as follows :—

Variety.	Area, in acres.	Yield.	
1	2	3	
		Mds.	srs.
King of Potatoes	1·125	175	18
Magnum Bonum	1	142	8
Up-to-date	0·37	69	23
Windsor Castle	0·5	72	33
British Queen (1909)	0·125	10	6
Imperator	0·05	4	14
Total	3·175	474	22

The average yield per acre amounted to a little over 149 maunds (5·5 tons) against 118 maunds (4·3 tons) in 1915.

Besides these 474 maunds, some 144 maunds of potatoes of the six varieties mentioned above were obtained from the experimental plots. The total outturn was thus 618 maunds, of which about half should be suitable for seed, and of the remainder, the larger tubers will be sold for table use and the small ones used for feeding the cattle on the farm.

The total outturn of potatoes grown last year (1915), taking the summer and winter crops together, was 1,411 maunds. It was disposed of as follows :—

	Mds.
Sold to Khasia cultivators	214
Supplied to Gauhati Seed Depôt and other places through the Deputy Director of Agriculture.	216
Sold direct from the farm to officials and private individuals oustide Khasi Hills.	6
Total quantity supplied for seed	596
Used on the farm for planting	382
Feed to farm stock	67
Sold for table use	190
Dryage and rottage	176
Total	1,411

The price charged to Khasia cultivators was the market price for table potatoes for the time being, and varied last year between Rs. 2 and Rs. 3 per maund against a slightly lower rate charged in the previous year.

While in storage on the farm the potatoes kept rather better than in the previous year. The quantity remaining after sale was used in feeding the cattle and sheep on the farm as a partial substitute for oilcake and grain, and the stock did well on this food.

The seed potatoes sold consisted of 263 maunds of King of Potatoes, 219 maunds of Magnum Bonum and the balance of the minor varieties.

Warping of rice land.

7. Experience for two years' running showed that some land which had been reclaimed in 1912-13 from a marsh for the purpose of rice cultivation was still unfit for the crop. The sterility of the soil was believed to be due to the fact that the upper layer was mostly composed of tough grass roots which were slow to decay and it contained very little of what might be called real soil. An experiment was made during the previous year to see if the land could be brought into a fit condition for growing rice by a process known as "warping" which consists in covering the land with a layer of soil deposited from water. This method is used by the Khasias for renovating worn-out rice-land.

One acre of land out of the area reclaimed in 1912-13 was taken for the purpose of this experiment. A slow current of water laden with soil thrown into it at a higher level was made to flow over the land. By shifting the current from place to place, the whole area was gradually covered with a layer of silt about 3″ thick. It was a rather costly operation, the total cost being no less than Rs. 1-8 for the one acre of land.

The land which is divided into 10 equal plots of $\frac{1}{10}$th of an acre each was sown with wet rice in the spring of 1915 and alongside it some similar but untreated land was sown at the same time for comparison. A better crop was obtained than in the previous year although it was still a light one. The yield on the warped land was 10 maunds 4 seers of grain and 19 maunds 16 seers of straw per acre, while on the unwarped land the rates were 8 maunds 35 seers of grain and 17 maunds 3 seers of straw. This increased yield of 1 maund 9 seers of grain and 2 maunds 13 seers of straw is a very small one considering the expenditure incurred, but probably a greater difference may be shown in the future and at any rate the improvement may be expected to be a permanent one.

New crops.

8. *Buck Wheat.*—This crop has been recently introduced into the district by Nepalese settlers, and although the returns have not been very large, it should prove a popular crop on the Khasi Hills, as the cost of cultivation is so very small. When the seed is sown immediately after potatoes have been dug, no extra cultivation is required. On the farm this course has been followed satisfactorily for the past two years. Last year the crop grew very well until the frosts set in

which unfortunately was rather early in the season. Afterwards little growth was made and the yield was disappointing. The Buck Wheat seed was sown on August 15th on $1\frac{3}{10}$ths acre, the crop matured in November and was then harvested, the yield of grain being only 3 maunds 4 seers.

The straw was used as fodder, and the grain has been kept over to provide the present season's requirements.

Rhubarb.

This crop was first planted in 1912 on a plot of land about $\frac{1}{10}$th of an acre in extent, a further plot of $\frac{1}{20}$th of an acre was planted in 1915. The land was manured with cowdung in the winter of 1915-16 at the rate of 300 maunds per acre.

The plants grew vigorously and a total of 5 maunds 33 seers of stalks was sold realizing Rs. 58-4.

The plants are growing well.

Asparagus.

This was planted in October 1912, and now occupies one-quarter of an acre. The plot was manured last winter with cowdung at the rate of 300 maunds per acre. The total quantity of shoots obtained was $16\frac{1}{2}$ seers which was sold for Rs. 12-10-0.

Strawberries.

The original plot which had been planted in 1912 was abandoned, as the plants had ceased to be prolific.

The plot of $\frac{1}{20}$th acre planted in 1914 was manured last winter with cowdung and bonemeal at the rate of 300 maunds and 3 maunds per acre respectively.

The plants are growing well, but owing to drought in February and March, they flowered late in the season and a short crop was the result.

About 16 lbs. of fruit have been picked and sold during the year and the return therefrom was Rs. 12-3-0.

Other fruits, etc.

A few of the trees on the farm bore fruits. These were sold and realized the following sums :—

	Rs.	a.	p.
Apples	26	6	6
Peaches	1	4	0
Chestnuts	16	7	0

Fodder crops.

9. The following fodder crops were grown during the year :—

Names of crop.	Area sown.	Cost of cultivation.	Outturn of green fodder.
1	2	3	4
	Acres.	Rs. a. p.	Mds. srs.
Maize	7.25	302 6 0	444 31
Job's tears	6·05	177 7 4	228 9
Langtylli grass	·5	...	7 2
	13·8	479 13 4	679 2

The maize crop gave a rather poor yield. Job's tears did much better than in the previous year. The *langtylli* grass, which was planted in 1910 and seemed quite promising in the beginning, gradually dwindled away and gave very little fodder during the year. It has since been uprooted.

The whole of the fodder (679 maunds) was made into ensilage. From this quantity of green material 512 maunds or 75 per cent. was recovered as ensilage of good quality.

The total cost of silage was Rs. 497-10-10, made up of cost of cultivation Rs. 479-13-4, cost of chopping the fodder and packing it in the silo Rs. 17-13-6.

The proportion of loss through decay around the sides of the pit in which the ensilage was made, was much smaller than in the previous year. Notwithstanding this, the cost per maund of silage was 15 annas as compared with 8½ annas in the previous year. The higher cost this year was the outcome of the much smaller crop of maize dealt with.

Raishan (*paspalum sanguinale*) has been successfully grown as a hay crop since 1912 and has proved a valuable winter food for the cattle. *Raishan* was grown on an area of 11 acres and the produce was made into hay and stored along with some purchased paddy straw and fed to the cattle during the winter months.

A total amount of 413 maunds 17 seers of this mixed hay and straw was fed during the year. The cost including the purchased straw was Rs. 428-7-8 or a little over Re. 1 per maund of hay.

The quality of this fodder was good, and all was eaten by the cattle.

Cattle breeding.

10. The following table shows the number of cattle in the herd on 30th June 1916 :—

Description.	Patna (P).	Bhutia (B).	P × B.	P × B × P.	P × B × P × P.	P × B × P × P × P.	P × Khasia (K).	P × K × P.	Total on 30th June 1916.	Total on 30th June 1915.	Total on 30th June 1914.	Remarks.
1	2	3	4	5	6	7	8	9	10	11	12	13
Breeding bulls ...	2	...	...	...	...	...	...	...	2	2	2	
Bulls (3 years and above)...	1	...	...	1	...	...	2*	...	4	3	11	*Are being used as plough cattle.
,, (2 to 3 years) ...	2	...	1	...	...	...	...	...	3	5	5	
,, (1 to 2 years) ...	4	...	1	3	1	...	...	...	9	2	4	
,, (under 1 year) ...	3	...	...	1	3	1	...	...	8	10	2	
Heifers (2 to 3 years) ...	1	...	1	4	3	...	...	...	9	5	3	
,, (1 to 2 years) ...	4	...	...	1	1	...	...	...	6	9	6	
,, (under 1 year) ...	9	...	1	2	...	...	...	...	12	7	9	
Cows	12	1	5	2	5	...	...	...	25	21	17	
Total on 30th June 1916	38	1	9	14	13	1	2	...	78	...	...	
Total on 30th June 1915	31	1	9	12	9	...	2	...	...	64	...	
Total on 30th June 1914	25	1	9	17	1	...	2	4	...	...	59	

In addition to the above, there were 3 Hindustani and 7 Khasi bullocks. The total number of cattle was therefore 88 against 74 on the corresponding date of last year.

No cattle were brought during the year.

The demand for bulls bred at the farm still far exceeds the supply. During the past year only three were available and these were sold to cultivators in the Khasi Hills.

The total yield of milk during the year amounted to 3,125 gallons, out of which about 140 gallons were fed to calves and the remainder was sold at the rate of 16lbs. for the rupee.

The cost of maintenance of the herd amounted to Rs. 4,485-4-9 against Rs. 5,119 in the previous year. The income from the sale of milk amounted to Rs. 1,949-8-6 against Rs. 1,052-15-0 and the value of the cattle sold to Rs. 180 against Rs. 445 in the previous year.

The half-English Patna cattle and the progeny of their cross with Khasia and Bhutia breeds have proved remarkably well adapted to the climate of the Khasi Hills. In respect of milking capacity, these cattle stand head and shoulders above any cattle on this side of India. Several of the cows on the farm have yielded over 200 gallons of milk in the season and one reached the very handsome total—for a cow of this type—of 271 gallons for the eight months during which she was giving milk.

After many years of work, we have got together a fine stock of milk cattle the like of which is not to be seen within many hundred miles of Shillong, and which promises to improve further by selection and crossing. It would be a comparatively easy matter to increase the herd so as to make it possible for us to sell cows and heifers to the public. There is a great demand for female stock bred at Upper Shillong, but we cannot afford to sell any at present. Some of our cows might easily fetch Rs. 200 or more if offered for sale.

The cost of maintaining the herd is undoubtedly high, but it has been somewhat reduced in recent years and it would seem that still further reduction is possible. It may be possible to reduce the expenditure by separating the cows from the rest of the herd, and maintaining them purely with a view to profit.

That the Upper Shillong cattle are being more and more appreciated is evident from the growing desire of cow owners in the Shillong station for the services of bulls bred on the farm.

One of the two breeding bulls on the farm has become too old for service, and the other, though comparatively young, needs to be soon replaced in order to avoid the evil effects of in-breeding. An endeavour was made during the previous year to import a fresh bull from Patna, but it transpired that in consequence of indiscriminate breeding in recent years, cattle answering to the pure Patna type have become nearly extinct in that locality. We have been advised to import an Ayrshire bull for the farm and steps are being taken for the purpose.

Sheep breeding.

11. The results of the sheep-breeding experiments have been so disappointing that it has been decided to discontinue that work. The climate was evidently unsuitable, as the sheep did not remain healthy and

the amount of wool produced was very small; another serious drawback to sheep breeding in the Khasi Hills is the fact that, during the cold weather, there is no pasturage and that makes it necessary to hand-feed during the winter months at very heavy cost.

The flock had gradually become smaller and smaller through deaths by disease and the few that remained were sold off at the end of the year.

Distribution of seed and plants.

12. The following were the seeds and plants supplied to agriculturists during the year:—

			Mds.	Srs.	Number.
Seed potatoes	...	...	596	12	...
Rhubarb roots	...	...	...		159
Strawberry plants	...	...	...		40
Pear grafts	...	...	...		4
Oilcake for manure	...	...	21	12	...

Establishment.

13. Mr. Harrick Singh continued in the position of Farm Superintendent during the year.

U Bendramoney was appointed to the position of Farm clerk towards the end of the previous year and occupied that post throughout the year.

The three apprentices, Paschalis Hoverwell, U Rodie Singh and Henry W. Momin, have continued their apprenticeship during the year.

Receipts and expenditure.

14. The total receipts including the value of seed potatoes supplied for demonstration purposes in the Assam and Surma Valleys were Rs. 5,656-14-11 against Rs. 4,527-2-3 in the previous year.

The sale of milk produced Rs. 1,949-8-6, the sale of cattle Rs. 180, while potatoes sold direct from the farm realized Rs. 1,165-8-4, and in addition potatoes to the value of Rs. 1,938-0-6 were supplied for demonstration purposes throughout the province.

The total expenditure for the year amounted to Rs. 12,299-5-4 against Rs. 15,450-5-11 in the previous year.

Much of the material for this report was prepared by Rai Bahadur B. C. Basu.

SHILLONG:
The 5*th August* 1916.

J. W. McKAY,
Deputy Director of Agriculture,
Surma Valley.

ANNUAL REPORT OF THE FRUIT EXPERIMENT STATION, SHILLONG, FOR THE YEAR ENDING THE 30TH JUNE 1916.

1. *Introductory.*—The fruit station commenced work in October 1912. Planting was commenced in the spring of 1913. The land is situated on the south side of the Jowai road, distant about a mile from Shillong. The elevation of the land is about 5,100 feet. The total area of the grant is 48·28 acres, of which only about 20 acres is suitable for fruit growing. 17¼ acres have been planted.

2. *Lower garden.*—No extension to this block has been made since 1913-14 and the planted area remains at 4¼ acres in grounds of 6·13 acres. The fruit trees are planted 15′ × 15′ diagonally. The soil of this block varies from light sandy loam lying above stone to heavier loam of good depth. The trees have done better on the heavier loam, the growth there being very satisfactory. On the lighter soil the stronger growing varieties of Apples—Bramleys Seedling, Crimson Bramley, Newton Wonder, Norfolk Beauty, Alfriston, Lane's Prince Albert, Allington Pippin have done best. The varieties Sanspareil, Duke of Devonshire, Allen's Everlasting, Syke House Russet will be transplanted to stronger soil next Autumn. On the heavier loam James Grieve, Kerry Pippin, Sturmer Pippin, Bens Red, Red Victoria, Bismarck, Peasgood Nonsuch promise to succeed. The plum trees that show weak growth will be removed to the Upper garden. The Pear trees show fair growth, but few varieties flowered, and only William bon Chretien, Dr. Jules Guyot, and Fondant Thirriot set fruit. The Cherry trees look healthy and have grown well, the Kentish and Morello trees bearing fruit. The Duke of York, Peregrine, and Kestrel Peach trees bore good sound well-coloured fruit. Merryweather's Damson is most promising and the fruit is everything the raisers Messrs. Merryweather and Sons claim for it. The Giant Himalaya Berry of California, and the Blowers, have done best of the varieties of Blackberries; and the Kings Acre berry, the best of the Hybrid Berries. The Hawthorn-leaved Berry (*Rubus Cratægifolius*) has grown strongly, but has not borne fruit. November Abundance and Park Lane have grown the strongest canes of the Raspberries, the first named promising best. The Devon, and Royal, varieties will be moved to the Upper garden in the hope that stronger canes will result. The Royal Sovereign

and Laxton Cropper have succeeded the best of the strawberries, bearing excellent fruit. New beds of Givons Late Prolific have been planted. Gooseberries are not suitable for the climate and only two bushes of those planted have survived. The red and white Currant bushes have put on little growth and have not fruited. The Black Currants look more promising, but have not fruited. The land has been kept well cultivated during the year. Winter spraying with Lime Sulphur solution has induced strong healthy foliage. The apple trees were banded as a precaution against the Codlin moth. The greater percentage of the Apples gathered have been worm-free, but worm found in some gives warning that calyx spraying will be necessary, and probably later applications during the summer to ensure good crops of sound fruit.

3. *Upper garden.*—The area planted is 13 acres, of which 10½ acres was planted in 1913-14, 2 acres in 1914-15, ½ acre in 1915-16. It is divided into 5 blocks, *viz.*,—

Top block.—Area 1¾ acres planted in 1913-14 with Bush Apple trees 15′ × 15′ diagonally.

North block.—Area 1½ acres planted in 1913-14 with Standard Apple trees 34′ × 34′ diagonally, interplanted with Bush Apple trees 17′ × 17′.

South block.—Area 1½ acres planted with Standard Apple trees 30′ × 30′ diagonally, interplanted with Bush Apple trees 15′ × 15′, ¾ acre planted in 1913-14, ¼ acre planted in 1914-15, ½ acre planted in 1915-16.

East block.—Area 7 acres planted with Standard Apple trees 34′ × 34′ diagonally, interplanted with Bush Apple trees 17′ × 17′— 5½ acres planted in 1913-14, 1½ acres planted in 1914-15.

West block.—Area 1¼ acres planted with Standard Pear trees 25′ × 25′ diagonally, interplanted with Bush Pear trees 12′ 6″ × 12′ 6″—1 acre planted in 1913-14, ¼ acre planted in 1914-15.

In the south block 40 Standard Apple trees were planted in the place of Bush trees which were moved to an extension of the same block, and a further 23 Standard and 36 Bush Apple trees were planted in the extension. The soil is a good loam of about 12 inches depth, lying on a reddish sub-soil. Small plots have a hard pan sub-soil about 2½ feet from the surface.

The whole of the planted area has been terraced with stone and banks. It has successfully prevented the denudation of the soil by rainfall.

Five hundred Paradise stock, and 1,800 Crab stock, for Apple grafting are planted 3 feet apart in rows between the trees in the East block. Similarly 2,000 Crab stock have been planted in the

North block ; and 1,100 Quince stock and 900 Pear stock for Pear grafting in the West block.

The whole of the planted area has been fenced with Page's wire fencing 4′ 10″ high with iron standards.

The following trees are in Nurseries for future planting :—

Description.	South block, 1915 trees.	South block, 1916 trees.	East block, 1915 trees from Kashmir.	East block, 1915 and 1916 trees.	Total.
1	2	3	4	5	6
Standard Apple trees ...	296	134	223	299	952
Bush " " ...	126	276	...	49	451
Standard Pear " ...	119	6	...	8	133
Bush " " ...	2	...	41	23	66
Cherry " ...	1	4	29	...	34
Apricot " ...	...	...	7	...	7
Walnut " ...	...	...	11	...	11
Plum " ...	29	11	4	45	89
Almond " ...	...	...	35	...	35
Sweet Chestnut " ...	7	...	...	...	7
Pecan nut " ...	9	...	...	...	9
Barberry bushes ...	...	...	...	4	4
Black currant " ...	7	24	...	...	31
White currant " ...	...	5	...	...	5
Red currant " ...	...	5	...	...	5
Gooseberry " ...	..	4	...	...	4

The following varieties of Apples bore good fruit on the Bush trees :—James Grieve, Rev. W. Wilks, Sturmer Pippin, Kerrys Pippin, Bismarck, Encore, Lane's Prince Albert, Rival, Charles Ross, Emneth Early, Red Victoria, Newton Wonder, Bramley, Seedling, Crimson Bramleys Seedling, Domino, Lady Sudeley Peasgood Nonsuch, Bens Red, Alfriston, Sterling Castle, Baumanns Reinette, Brownlees Russet, Cardinal, Scarlet Nonpareil, Herrings Pippin, Golden Spire, Grenadier.

In the Nurseries, the following varieties of Apples bore excellent fruit on the Bush trees :—Ellison's Orange, Renown, Beauty of Bedford, Devon Queen, Upton Pyne, Ardcairn Russet, Royal Jubilee, William Crump, Charles Eyre. Only the following of the Bush Pear trees bore fruit :—Princess, William bon Chretien, Marguerite Marillat, Fertility, Dr. Jules Guyot, Doyenne d'Ete, Fondante Thirriot.

The Apple trees pruned out well, and have put on very satisfactory growth. The Bush Pear trees on Quince stock had a dwarfed appearance until the junction of the graft was covered with soil, when they improved.

The Establishment consists of an Overseer on a monthly salary of Rs. 25, 2 Khasi apprentices, and 8 Khasi malis on a monthly salary of Rs. 15 each. All have worked well and take great interest in their work.

4. *Varieties planted.*—The following statement shows the number and varieties of fruit trees planted :—

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Apple trees ..	James Grieve ...	60	74	148	58	6	40	386	Bush.
	Boston Russet ...	...	2	12	...	...	...	14	
	Bens Red ...	...	...	10	10	...	9	29	
	Alfriston ...	...	...	30	...	...	9	39	
	Egremont Russet ...	10	...	...	8	...	...	18	
	Annie Elizabeth ...	...	...	20	...	...	...	20	
	Claygate Pearmain ...	8	...	...	10	...	...	18	
	Lord Hindlip ...	...	...	10	...	...	...	10	
	Mannington Pearmain	6	...	...	8	4	...	18	
	Winter Queening of Kent.	...	...	10	...	...	...	10	
	Pineapple Russet ...	...	...	...	9	...	...	9	
	Edward VII ...	...	...	9	...	...	...	9	
	Red Juneating ...	6	...	...	2	...	10	18	
	Flower of Kent ...	...	...	8	...	...	...	8	

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Barnack Beauty ...	...	...	...	6	6	...	12	Bush.
	Coronation ...	...	...	6	4	4	...	14	
	Wealthy ...	...	...	...	4	6	...	10	
	Feltham Beauty ...	...	...	10	...	...	...	10	
	Norfolk Beauty ...	8	...	...	10	...	10	28	
	Christmas Pearmain...	...	...	10	...	...	...	10	
	Yorkshire Beauty ...	5	...	...	1	...	...	6	
	Kings Acre Pippin ...	...	...	6	...	...	...	6	
	Crimson Bramley ...	15	...	18	...	...	5	38	
	Royal Snow ...	...	...	10	...	...	...	10	
	Bramley's Seedling ...	15	...	15	...	5	11	46	
	Kings of Tompkins County.	1	...	7	2	...	...	10	
	Houblon ...	...	...	6	...	...	...	6	
	Roundway Magnum Bonum.	6	...	...	...	...	3	9	
	Wellington ...	...	...	5	...	...	...	5	
	Lane's Prince Albert	14	2	20	...	1	10	47	
	Upton Pyne ...	1	3	6	...	...	...	10	
	Devon Queen ...	4	1	2	...	...	...	7	
	Renown ...	...	4	...	...	...	...	4	
	Stirling Castle ...	10	...	10	...	...	...	20	
	Golden Russet ...	...	...	6	...	...	...	6	
	Charles Ross ...	10	...	10	...	...	...	20	
	Bismarck ...	...	...	17	8	6	6	37	
	Rymer ...	6	...	...	...	...	...	6	
	Warner's King ...	...	...	...	...	...	11	11	
	Thomas Rivers ...	10	...	...	...	...	...	10	
	Grenadier ...	...	2	17	...	...	...	19	
	Rev. W. Wilks ...	19	...	6	...	...	9	34	
	Hounslow Wonder ...	...	1	20	...	...	6	27	
	Newton Wonder ...	15	...	21	...	...	10	46	
	Red Victoria ...	...	4	11	...	...	10	25	
	Potts' Seedling ...	4	...	5	...	...	10	19	
	Hector McDonald ...	...	...	20	...	...	10	30	

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Domino ...	14	...	...	...	...	...	14	Bush.
	Rival	...	...	16	...	...	...	16	
	Wadhurst Pippin ...	10	...	...	...	...	...	10	
	Court Pendu Plat ...	6	...	6	...	...	...	12	
	Ecklinville Seedling...	4	...	4	...	...	...	8	
	Early Red Margaret...	...	...	10	...	...	...	10	
	Gascoyne's Scarlet ...	4	...	5	...	...	...	9	
	Spitzenberg ...	...	...	6	...	...	...	6	
	Braddicks Nonpareil...	5	...	...	...	...	...	5	
	White Nonpareil ...	10	...	...	...	...	...	10	
	Baumann's Reinette...	6	7	8	...	...	...	21	
	Pitmaston Pineapple	10	...	...	...	...	...	10	
	Brownlee's Russet ...	10	...	...	...	...	...	10	
	Sturmer Pippin ...	5	6	16	...	12	9	48	
	Cardinal ...	...	...	9	1	...	...	10	
	Emneth Early ...	...	3	16	...	...	...	19	
	Langley Pippin ...	...	...	10	...	...	...	10	
	Wagener ...	...	...	9	...	...	...	9	
	Williams' Favourite...	10	...	...	...	...	...	10	
	Scarlet Nonpareil ...	...	...	10	...	...	13	23	
	Lord Burghley ...	1	...	...	...	3	...	4	
	St. Everard ...	...	6	...	...	...	...	6	
	Beauty of Bedford ...	...	3	...	...	...	...	3	
	Reinette doree de Heusgen.	10	...	...	...	...	...	10	
	Coe's Golden Drop ...	...	...	...	...	...	6	6	
	Cox's Orange Pippin	...	...	...	...	24	...	24	
	Kerry Pippin ...	...	10	16	...	...	10	36	
	Sanspareil ...	...	...	...	...	6	...	6	
	Golden Reinette ...	...	...	...	...	...	6	6	
	Peasgood Nonsuch ...	...	...	26	...	6	9	41	
	Fearn's Pippin ...	...	...	12	...	...	6	18	
	Lady Sudeley ...	...	...	20	...	4	6	30	
	Devonshire Quarrenden	...	...	...	...	...	17	17	

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Duke of Devonshire...	...	...	...	...	6	...	6	Bush.
	Yellow Ingestre ...	...	...	...	...	...	6	6	
	Allen's Everlasting ...	...	...	...	...	6	...	6	
	Ardcairn Russet ...	...	7	6	1	...	5	19	
	Allington Pippin ...	...	16	5	...	4	...	25	
	William Crump ...	...	8	19	...	2	6	35	
	Worcester Pearmain...	...	...	...	...	6	...	6	
	Herring's Pippin ...	4	6	3	...	...	1	14	
	Beauty of Bath ...	...	1	5	...	6	...	12	
	Ellison Orange ...	...	...	...	...	...	1	1	
	Ribston Pippin ...	...	...	...	...	12	...	12	
	Charles Eyre ...	...	...	3	...	...	1	4	
	Syke House Russet ...	...	...	...	...	6	...	6	
	Spring Ribston Pippin	...	...	8	...	...	...	8	
	Mr. Gladstone ...	...	...	6	...	5	...	11	
	Golden Spire ..	...	14	...	...	...	...	14	
	Rosemary Russet ...	...	...	6	...	6	...	12	
	Early Peach ...	...	10	...	...	...	...	10	
	Newtown Pippin ...	...	2	8	...	6	...	16	
	American Mother ...	...	9	...	...	...	...	9	
	Encore ...	...	...	18	...	4	...	22	
	Irish Peach ...	...	6	...	...	...	...	6	
	Total ...	342	207	807	142	162	281	1,941	
	Crimson Bramley ...	...	5	6	10	...	...	21	Standards.
	Rhymer	...	...	...	...	...	8	8	
	Bramley's Seedling ...	...	...	8	13	...	...	21	
	Court of Wick ...	...	...	6	...	...	...	6	
	Irish Peach ...	...	...	...	6	...	...	6	
	Northern Greening ...	...	...	...	...	...	8	8	
	Norfolk Beefing ...	...	...	...	6	...	...	6	
	Newton Wonder ...	...	4	21	...	...	...	25	
	Stirling Castle ...	...	...	5	1	...	5	11	

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Duchess of Oldenburg	...	...	6	...	...	...	6	Standards.
	Norfolk Bearer ...	...	...	5	1	...	...	6	
	King of Tompkins County.	...	...	6	...	...	...	6	
	Emperor Alexander ...	...	...	...	6	...	...	6	
	James Grieve ...	...	3	18	...	...	...	21	
	Cox Pomona ...	...	...	2	4	...	...	6	
	Small's Admirable ...	...	...	6	...	...	...	6	
	New Hawthorden ...	...	...	5	...	...	...	5	
	Delicious (Starks)	...	...	12	...	...	...	12	
	King David ,, ...	...	...	12	...	...	...	12	
	York Imperial ,, ...	...	...	6	...	...	...	6	
	Paragon Winesap ,, ...	...	...	5	...	...	...	5	
	Jonathan ,, ...	...	...	6	...	...	...	6	
	Black Ben ,, ...	...	...	5	...	...	...	5	
	Stayman Winesap ,, ...	...	...	6	...	...	...	6	
	Senator ,, ...	...	...	6	...	...	...	6	
	Grimes Golden ,, ...	...	...	5	...	...	...	5	
	Mother ,, ...	...	...	6	...	...	...	6	
	Emneth Early ...	...	...	10	...	...	...	10	
	Baumann's Reinette...	...	...	10	...	...	...	10	
	Grenadier	...	...	8	...	...	...	8	
	Cox's Orange Pippin...	...	...	16	...	...	...	16	
	Blenheim Orange ...	...	3	9	...	...	...	12	
	Calville Blanc ...	...	...	6	...	...	...	6	
	Norfolk Beauty ...	...	15	13	...	...	...	28	
	Reinette du Canada ...	...	6	...	...	...	...	6	
	Winter Greening ...	...	8	...	...	...	...	8	
	Rev. W. Wilks ...	...	1	...	...	...	...	1	
	Lord Burghley ...	...	6	...	...	...	...	6	
	Lady Henniker ...	...	4	6	...	...	...	10	
	Golden Spire ...	...	4	5	...	...	...	9	
	Bismarck ..	..	4	6	...	...	...	10	
	Calville Rouge d'hiver	...	...	...	...	1	...	1	

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Early Melon (Starks)	...	...	4	...	...	...	4	Standards.
	Wealthy (,,)	...	...	4	...	...	...	4	
	Wilson's Red June (Starks).	...	...	6	...	...	...	6	
	Liveland Raspberry (Starks).	...	...	6	...	...	...	6	
	Total ...	...	63	272	47	1	21	404	
	Blenheim Orange ...	...	...	2	11	...	...	13	Horizontal trained.
	James Grieve ...	...	...	...	...	4	...	4	
	Feltham Beauty ...	...	...	2	3	...	...	5	
	Lady Sudley ...	2	...	...	...	3	...	5	
	Herring's Pippin ...	...	...	2	1	2	...	5	
	Gascoyne's Scarlet ...	3	...	...	...	...	...	3	
	Charles Ross ...	3	...	...	...	...	...	3	
	Brownlees Russet ...	3	...	...	...	2	...	5	
	Baumann's Reinette...	3	...	...	...	...	...	3	
	Beauty of Bath ...	...	...	...	...	5	...	5	
	Sturmer Pippin ...	6	...	...	...	...	...	6	
	Cox's Orange Pippin	...	...	...	...	...	1	1	
	Cox Pomona ...	1	...	...	...	3	...	4	
	King of the Pippins...	...	...	3	...	...	2	5	
	Kerry Pippin ...	...	...	...	...	...	1	1	
	Claygate Pearmain ...	...	...	...	...	...	1	1	
	King of Tompkins County.	...	...	3	...	...	...	3	
	Sterling Castle ...	...	...	...	...	3	...	3	
	Total ...	21	...	12	15	22	5	75	
	Sturmer Pippin ...	...	...	...	3	...	...	3	Upright trained.
	Mannington Pearmain	...	...	...	3	...	...	3	
	Scarlet Golden Pippin	...	...	...	...	...	2	2	
	Washington ...	2	...	2	2	...	...	6	
	Allington Pippin ...	...	...	...	...	...	2	2	

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Apple trees ...	Golden Spire ...	...	...	1	...	...	...	1	Upright trained,
	Beauty of Bath ...	...	...	...	...	...	2	2	
	Adams Pearmain ...	2	...	...	1	...	...	3	
	James Grieve ...	...	...	...	...	...	2	2	
	King of the Pippins...	...	...	2	1	...	...	3	
	Barnack Beauty ...	...	...	...	...	...	2	2	
	King of Tompkins County.	...	...	...	6	...	...	6	
	Total ...	4	...	5	16	...	10	35	
	Charles Ross ...	...	...	6	...	...	...	6	Palmette Verrier trained.
	Rival	...	...	5	...	...	...	5	
	James Grieve ...	...	...	6	...	...	...	6	
	Blenheim Orange ...	...	...	6	...	...	...	6	
	Total ...	...	...	23	...	...	...	23	
	Baumann's Reinette...	4	...	...	...	...	...	4	Fan trained.
	Golden Spire ...	1	...	...	...	...	...	1	
	Total ...	5	...	...	...	...	...	5	
	Rival	...	...	3	...	...	...	3	Double Cordon.
	Total ...	...	...	3	...	...	...	3	
	Rival	...	...	3	...	...	...	3	Single Cordon.
	Total ...	...	...	3	...	...	...		

Species of fruit trees.	Variety.	Planted 1913-16.				Planted 1912-13.	Total number.	Description.
		Upper garden.						
		Top block.	West block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Pear trees	Fertility	...	55	...	...	18	73	Bush and Pyramid.
	St. Swithins ...	...	...	...	...	10	10	
	Beurre Hardy ...	...	17	...	3	...	20	
	Red October ...	...	...	...	...	9	9	
	Beurre d'Anjou ...	...	6	...	...	...	6	
	Parrot	...	...	...	...	10	10	
	William's Bon Chretien.	...	13	...	...	...	13	
	Seedling Bergamot ...	...	...	...	...	6	6	
	Fondante Thirriot ...	...	10	...	...	10	20	
	Dr. Hogg... ...	...	...	...	...	8	8	
	Triemphe de Vienne	...	6	...	...	...	6	
	Beacon	...	...	...	...	7	7	
	Beurre de Naghan ...	...	...	...	...	6	6	
	Charles Ernest ...	...	12	...	...	...	12	
	Roosevelt	...	...	...	...	6	6	
	Doyenne d' Ete ...	...	10	...	...	...	10	
	Blicking	...	...	...	...	6	6	
	Gansels Bergamot ...	...	6	...	...	...	6	
	Santa Claus ...	...	...	...	...	6	6	
	Josephine de Malines	...	6	...	...	9	15	
	Precoce de Juillet ...	...	...	...	...	5	5	
	Dr. Jules Guyot ...	...	11	...	...	6	17	
	Madame Treyve ...	...	...	...	...	10	10	
	Durondeau ...	...	7	...	...	3	10	
	Hessle	...	5	...	1	13	19	
	Beurre d' Amanlis ...	...	12	...	...	10	22	
	Emile d' Heyst ...	...	5	...	...	10	15	
	Marie Benoist ..	...	6	...	...	...	6	
	Clapp's Favourite ...	...	5	...	...	10	15	
	Louise Bonne of Jersey.	...	2	...	...	...	2	
	President Barabe ...	...	5	...	...	...	5	
	Thompson ...	...	5	...	...	...	5	
	Winter Nelis ...	...	4	...	...	...	4	
	Marguerite Marillat...	...	6	...	...	...	6	

Species of fruit trees.	Variety.	Planted 1913-16.				Planted 19 2-13.	Total number.	Description.
		Upper garden.						
		Top block.	West block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Pear trees	Colmar d' Ete ...	...	6	...	...	...	6	Bush and Pyramid.
	Princess	...	6	...	...	...	6	
	Belle Julie ...	...	6	...	...	...	6	
	Total ...	...	232	...	4	178	414	
	Beurre Hardy ...	...	14	...	...	5	19	Single Cordon.
	Clapp's Favourite ...	...	10	...	...	...	10	
	Durondeau ...	...	8	...	...	...	8	
	Madame Treyve ...	...	10	5	...	..	15	
	William's Bon Chretien	...	9	...	...	5	14	
	Marguerite Marillat ...	...	12	...	...	5	17	
	Doyenne du Comice ...	...	10	...	...	5	15	
	Fondante Thirriot ...	...	...	5	...	...	5	
	Louise Bonne of Jersey	...	10	...	...	5	15	
	Conference ...	...	9	...	...	5	14	
	Emile d' Heyst ...	...	9	...	...	...	9	
	Winter Nelis ...	...	5	...	...	...	5	
	Fondante d' Automme	...	...	5	...	...	5	
	Beurre Superfin ...	...	...	...	...	5	5	
	Princess	...	...	5	...	5	10	
	Beurre Fonqueray ...	...	...	5	...	...	5	
	Beurre Diel ...	...	...	...	...	5	5	
	Directeur Hardy ...	...	...	5	...	...	5	
	Beurre d' Anjou ...	...	...	...	...	5	5	
	Colmar d' Ete ...	...	...	5	...	...	5	
	Total ...	...	106	35	...	50	191	
	Directeur Hardy ...	...	11	...	...	...	11	Horizontal trained.
	Duchess d' Angouleme	...	1	...	...	...	1	
	Clapp's Favourite ...	...	2	...	...	...	2	
	Josephine de Malines	...	1	...	...	...	1	
	Emile d' Heyst ...	...	2	...	...	...	2	
	Louise Bonne of Jersey	...	1	...	...	...	1	

Species of fruit trees.	Variety.	Planted 1913-16.				Planted 1912-13.	Total number.	Description.
		Upper garden.						
		Top block.	West block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Pear trees	Beurre Superfin ...	...	1	...	...	...	1	Horizontal trained.
	Princess	...	6	...	...	...	6	
	Conference ...	...	2	...	...	...	2	
	Dr. Jules Guyot ...	...	2	...	...	...	2	
	Durondeau ...	...	1	...	...	...	1	
	Pitmaston Duchess ...	...	1	...	...	...	1	
	Fondante d' Automne	...	1	...	...	...	1	
	Doyenne du Comice ...	...	2	...	...	...	2	
	Winter Nelis ...	4.	...	...	...	...	4	
	Marguerite Marillat ...	...	5	...	...	...	5	
	Total ...	4	39	...	...	...	43	
	King Karl (Starks) ...	...	1	...	...	...	1	Standards.
	Anjou (,,) ...	...	3	...	...	...	3	
	Lincoln (,,) ...	...	3	...	...	...	3	
	Howell (,,) ...	...	6	...	...	...	6	
	Duchess (,,) ...	...	3	...	...	...	3	
	Bartlett (,,) ...	...	8	...	...	...	8	
	Seckle (,,) ...	...	4	...	...	...	4	
	Marie Louise ...	...	2	...	...	...	2	
	Dr. Jules Guyot ...	...	5	...	...	...	5	
	Conference ...	...	2	...	...	...		
	Emile d' Heyst ...	...	3	...	...	...	3	
	Madame Treyve ...	...	8	...	...	...	8	
	Count de Lamy ...	...	3	...	...	...	3	
	Louise Bonne of Jersey	...	2	...	...	...	2	
	Beurre Capiaumont ...	...	6	...	...	...	6	
	Princess	...	2	...	...	...	2	
	Doyenne du Comice ...	...	2	...	...	...	2	
	William's Bon Chretien	...	2	...	...	...	2	
	Souvenir du Congress	...	2	...	...	...	2	
	Marie-Louise d' Uccle	...	2	...	...	...	2	
	Fertility	...	28	...	...	...	28	
	Total ...	...	97	...	...	...	97	

Species of fruit trees.	Variety.	Planted 1913-16.				Planted 1912-13.	Total number.	Description.
		Upper garden.						
		Top block.	West block.	East block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Pear trees	Princess	...	5	...	...	...	5	Upright trained.
	Conference ...	...	...	...	...	3	3	
	Madame Treyve ...	...	...	5	...	...	5	
	Marie Louise d' Uccle	...	...	...	...	4	4	
	Louise Bonne of Jersey	...	...	...	...	4	4	
	Beurre Hardy ...	5	...	...	...	...	5	
	Fondante d' Automne	...	...	...	...	3	3	
	Winter Nelis ...	...	...	...	4	...	4	
	Conseiller de la Cour...	...	...	...	...	3	3	
	Doyenne du Comice ...	...	...	...	...	3	3	
	Marguerite Marillat ...	4	2	...	...	...	6	
	Total ...	9	7	5	4	20	45	

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Plum trees ...	Late Transparent ...	...	...	...	...	6	...	6	Bush.
	Deniston's Superb Gage.	...	...	...	...	...	10	10	
	Satsuma	...	...	...	...	1	...	1	
	Jefferson... ...	...	...	...	...	3	...	3	
	Belle de Lonvain ...	...	...	...	...	...	6	6	
	Curlew	...	...	...	...	1	...	1	
	Greengage ...	...	...	...	...	6	5	11	
	Bittern	...	...	...	...	1	...	1	
	Cox's Emperor ...	...	...	...	...	...	6	6	
	Monarch	...	...	3	...	...	...	3	
	Stark's Gold ...	3	...	...	...	...	...	3	
	Belgian Purple ...	...	...	...	...	...	10	10	
	Rutland Plumcot ...	1	...	...	...	...	...	1	
	Pond's Seedling ...	...	...	...	...	3	6	9	
	Stark's Shiro ...	1	...	...	...	...	...	1	
	Early Transparent ...	...	...	...	...	...	5	5	
	Stark's Omaha ...	...	...	1	...	1	...	2	
	Autumn Beauty ...	...	...	1	...	...	3	4	
	Guthrie's Late Gage ...	...	...	...	...	...	5	5	
	Reine Claude de Bavay	...	...	...	...	...	3	3	
	Victoria	...	...	...	...	...	9	9	
	Czar	...	...	...	...	...	6	6	
	King of the Damsons	...	...	...	...	2	...	2	
	Shepherd's Bullace ...	...	...	...	...	3	...	3	
	Langley's Bullace ...	...	...	...	...	3	...	3	
	White Damson ...	...	...	...	...	3	...	3	
	Prune Shropshire ...	...	...	...	...	3	...	3	
	Merryweather Damson	...	...	...	...	6	...	6	
	Stark's America ...	...	...	2	...	...	...	2	
	Burbanks Giant Prune	...	...	...	...	...	4	4	
	Total ...	5	...	7	...	42	78	132	

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	West block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Plum trees ...	Decaise	...	...	...	...	1	...	1	Fan trained.
	Kirkes	...	...	...	...	2	...	2	
	Jefferson	...	...	...	...	2	...	2	
	Mallard	...	...	...	...	1	...	1	
	Golden Esperen ...	...	...	...	...	1	...	1	
	Oullin's Golden Gage...	...	...	...	...	2	...	2	
	Reine Claude d' Althan	...	...	...	...	1	...	1	
	Early Transparent ...	...	...	...	...	1	...	1	
	Coe's Golden Drop ...	...	...	...	...	1	...	1	
	Transparent Gage ...	...	...	...	...	1	...	1	
	Greengage ...	...	...	...	...	2	...	2	
	Golden Transparent Gage.	...	...	...	...	1	...	1	
	Belgian Purple ...	...	...	...	...	1	...	1	
	Total ...	...	...	...	...	17	...	17	
Cherry trees ...	Morello	...	...	...	3	3	...	6	Trees.
	Kentish	...	...	...	...	...	16	16	
	Bigarreau Kentish ...	...	...	...	...	...	6	6	
	Gloire de France ...	...	...	...	...	...	5	5	
	White Heart ...	...	...	...	...	...	4	4	
	Black Heart ...	...	...	...	...	...	5	5	
	Kashmir	...	12	...	...	...	...	12	
	Montmorency King ...	...	1	...	...	...	...	1	
	Total ...	...	13	...	3	3	36	55	
	Turkey Black Heart...	...	...	...	...	1	...		Fan trained.
	Late Black Bigarreau...	...	...	...	...	1	...	1	
	Frogmore Bigarreau..	...	...	...	...	1	...	1	
	Noir de Guben ...	...	...	...	...	1	...	1	
	Belle de St. Trone ...	...	...	...	...	1	...	1	
	Early Rivers ...	...	...	...	...	1	...	1	
	Total ...	...	...	...	...	6	...		

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	West block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Orange trees ...	Japanese Satsuma ...	...	...	...	...	2	...	2	Trees.
	Japanese Kumquot ..	...	4	...	...	8	...	12	
	Malta Blood ..	...	4	...	...	3	2	9	
	St. Michael's ...	...	1	...	...	3	...	4	
	Jaffa	...	...	...	...	1	3	4	
	Malta Oval ...	...	1	...	...	1	1	3	
	Silver	...	2	...	...	...	3	5	
	Excelsior	...	...	...	...	2	...	2	
	St. Michæl's Tangierin.	...	...	..	...	...	6	6	
	St. Michael's Dom Louise.	...	...	...	...	3	...	3	
	St. Michael's Sustain	...	1	...	...	...	1	2	
	Ditto Achilles...	...	...	...	...	...	1	1	
	Total ..	...	13	...	...	23	17	53	
Lemon trees...	Imperial Lemon ...	...	...	...	...	...	2	2	
	Bijou ,, ...	...	...	...	...	4	...	4	
	Total ...	...	...	...	...	4	2	6	
Walnut trees...	Dwarf Prolific ...	...	...	...	...	...	10	10	
	Total ...	...	...	...	...	...	10	10	
Peach trees ...	Princess of Wales ...	...	...	...	3	...	...	3	
	Peregrine	...	...	...	...	3	13	16	
	Alexander ...	...	...	...	...	3	10	13	
	Duke of York ...	...	...	...	...	1	16	17	
	Exquisite	...	...	...	...	...	2	2	
	Late Devonian ...	...	...	...	...	2	...	2	
	Lady Palmerston ...	...	...	...	...	2	...	2	
	Kestrel	...	...	...	...	6	...	6	
	Hales Early ...	...	...	...	...	3	...	3	
	Total ...	...	...	...	3	20	41	64	

Species of fruit trees.	Variety.	Planted 1913-16.					Planted 1912-13.	Total number.	Description.
		Upper garden.							
		Top block.	South block.	East block.	West block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9	10
Apricot trees...	Superb (Starks) ...	...	...	...	...	1	...	1	Trees.
	Blenheim	...	...	...	...	6	...	6	
	Total ...	...	...	...	...	7	...	7	
Fig trees ...	White Marseilles ...	...	...	...	...	...	3	3	
	Bourjassotte Grise ...	...	...	...	...	...	3	3	
	Monaco Bianco ...	...	...	...	...	...	3	3	
	Total ...	...	...	...	...	...	9	9	

Species of fruit trees.	Variety.	Planted 1913-16.				Planted 1912-13.	Total number.	Description.
		Upper garden.						
		Top block.	West block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Wineberry...	......	...	...	...	6	...	6	Berries.
Lowberry...	......	...	...	...	...	6	6	
Rubus Cratægifolius.	......	...	...	...	5	...	5	
King's Acre Berry.	......	...	...	...	5	...	5	
Loganberry	......	...	...	...	3	1	4	
Phenomenal	......	...	...	...	3	1	4	
Laxtonberry	......	...	...	...	3	...	3	
Blackberry	Blowers	...	...	...	4	...	4	
Ditto ...	Pyne's Giant Himalaya Berry of California.	...	...	...	112	...	112	
	Total ...	...	...	...	141	8	149	
Raspberry	Pyne's Royal ...	20	...	...	...	...	20	Berries.
	Park Lane ...	...	...	...	8	...	8	
	November Abundance	...	...	...	7	...	7	
	Laxton's Bountiful ...	...	...	...	6	...	6	
	Pyne's Devon ...	...	...	...	6	...	6	
	Bunyards Goldendrop...	9	...	...	...	..	9	
	Total ...	29	...	...	27	...		
Strawberry.	Givon's late Prolific...	...	...	...	900	...		Plants.
	Louis Gauthier ...	...	...	...	350	...		
	Royal Sovereign ...	...	...	...	1,250	...	1,250	
	Laxton's Cropper ...	...	...	...	400	...	400	
	Total ...	...	...	...	2,900	...	2,900	
Currant	Raby Castle ...	...	...	...	2	...	2	Bushes.
	White Dutch ...	...	...	...	4	...	4	
	Scotch Red ...	...	...	...	5	...	5	
	Boskoop Giant Black...	...	...	...	2	...	2	
	Defender Black ...	...	...	...	1	...	1	
	Mervin Crystal Whit...	...	...	...	4	...	4	
	Southwell's Black ...	...	...	...	40	...	40	
	Total ...	...	...	...	58	...	58	

Species of fruit trees.	Variety.	Planted 1913-16.				Planted 1912-13.	Total number.	Description.
		Upper garden.						
		Top block.	West block.	North block.	Lower garden.	Lower garden.		
1	2	3	4	5	6	7	8	9
Gooseberry trees.	Keepsake Green ...	...	...	...	1	...	1	Cordon trained.
	Couzen's Seedling Yellow.	...	...	...	1	...	1	
	Total ...	...	...	...	2	...	2	
Nut trees...	White Filbert ...	...	...	...	2	...	2	Trees.
	Red Filbert ...	...	...	...	3	...	3	
	Prize Cob ...	...	...	...	3	...	3	
	Kentish Cob ...	...	...	...	3	...	3	
	Total ...	...	...	...	11	...	11	
Grape Vines.	Campbell's Early (Starks).	...	...	...	2	...	2	Vines.
	Hicks (Starks) ...	...	...	...	2	...	2	
	King (,,) ...	...	...	...	2	...	2	
	Eclipse (,,) ...	...	...	...	2	...	2	
	King Philip(,,) ...	...	...	...	2	...	2	
	Wilder (,,) ...	...	...	...	2	...	2	
	Worden (,,) ...	...	...	...	2	...	2	
	Total ...	...	...	...	14	...	14	

Summary of Fruit Trees planted to 30th June 1916.

——	1912-13.	1913-16.	Total.
1	2	3	4
Bush Apple trees	281	1,660	1,941
Standard „	21	383	404
Horizontal trained Apple trees ...	5	70	75
Upright „ „ „ ...	10	25	35
Palmette Verrier „ „ „ ...	...	23	23
Fan „ „ „ ...	...	5	5
Double Cordon „ „ „ ...	...	3	3
Single „ „ „ ...	...	3	3
Bush and Pyramid Pear „ ...	178	236	414
Single Cordon „ „ ...	50	141	191
Horizontal trained „ „ ...	...	43	43
Standard „ „ ...	...	97	97
Upright trained „ „ ...	20	25	45
Bush Plum trees	78	54	132
Fan trained Plum trees	...	17	17
Cherry standard trees	36	19	55
Cherry fan trained trees ...	...	6	6
Orange trees	17	36	53
Lemon „	2	4	6
Walnut „	10	...	10
Peach „	41	23	64
Apricot „	...	7	7
Fig „	9	...	9
Wineberry	...	6	6
Lowberry	6	...	6
Rubus Cratægifolius	...	5	5
Loganberry	1	3	4

—	1912-13.	1913-16.	Total.
1	2	3	4
King's Acre Berry	...	5	5
Phenomenal ,, ...	1	3	4
Laxtonberry ,, ...	...	3	3
Giant Himalaya Blackberry	...	112	112
Blower's Blackberry	...	4	4
Raspberry	...	56	56
Strawberry plants...	...	2,900	2,900
Currant Bushes	...	58	58
Gooseberry trees...	...	2	2
Nut trees	...	11	11
Grape Vines	...	14	14

C. H. HOLDER,

The 29*th July* 1916.

In charge, Fruit Experiment Station, Shillong.

Statement showing the Receipts and Expenditure of the Fruit Experiment Station, Shillong, from 1st *July* 1915 *to* 30*th June* 1916.

Receipts.	Amount.	Expenditure.	Amount.
	2	3	4
	Rs. a. p.		Rs. a. p.
Sale-proceeds of timber ...	23 8 0	Allowance to Superintendent	3,000 0 0
,, of strawberries	63 4 0	Establishment ...	2,436 0 0
,, of apples ...	42 0 0	Petty construction ...	893 6 4
,, of peaches ...	7 0	Plants and manures ...	4,203 5 9
		Instruments, appliances and machinery.	467 2 9
		Wages of labourers ...	2,719 9 0
		Other charges ...	1,799 1 3
Total Receipts ...	136 4 0	Total Expenditure ...	15,518

ANNUAL REPORT OF THE KARIMGANJ AGRICULTURAL EXPERIMENT STATION FOR THE YEAR ENDING THE 30TH JUNE 1916.

General.

This station or farm came into being in January 1914. It is situated on the Sylhet road, 3½ miles to the west of the subdivisional station of Karimganj which lies on the Assam-Bengal Railway.

The total area of the farm is a little under 80 acres. Leaving out a compact block of about 8 acres which has been set apart for the farmstead and quarters for the staff, and the area covered by roads and drains, the net area available for cultivation amounts to about 68 acres.

The station is devoted mainly to experimental work on rice and jute.

Character of land and soil.

2. The station lies close to the Langai river which occasionally rises in high flood and lays the country all round under water. This liability to floods is characteristic of the rice-lands in the locality.

The soil of the greater portion of the farm is a deep alluvial clay of fine texture, though not particularly heavy. In the higher lands, it is comparatively lighter in character and may be described as a medium loam. It has not yet been chemically analysed.

Equipment.

3. No new building was constructed during the year. A raingauge has been erected, and rainfall is being recorded since 1st March. The cost of erection was Rs. 20. The raingauge and a measuring glass were provided out of the stock of the Agricultural Department and cost nothing to the farm.

A long drain, leading from the south-east corner of the farm to a *khal* near by, was dug during the year for the purpose of draining the residential area, which in former years was often converted into a swamp in the rainy season.

Some difficulty has been experienced with the deeper part of this drain since the rain started. The banks are composed mainly of sand and in consequence have slipped rather badly in places. A scheme for stopping erosion of the banks and preventing back flow of flood-water is under consideration.

No cattle were purchased during the year. The total strength of working cattle remains at 30 animals as at the close of last year.

No new implements were purchased during the year. The two Meston ploughs, purchased in the previous year at Rs. 5 8-0 each, have been regularly used and proved quite satisfactory. The plough is appreciated by the cultivators near the farm, but they complain that their cattle are ordinarily too small and ill-fed to draw it.

A winnowing machine was purchased in the preceding year at a cost of Rs. 230. It was used for winnowing paddy and some 300 maunds of grain were cleaned by it. It did the winnowing well, but the machine is so flimsy that it is apt to get out of order frequently, resulting in great waste of time.

Character of the year.

4. The official agricultural year is found extremely inconvenient for the purpose of report. It covers the latter half of one *kharif* season and first-half of the *kharif* season following, and includes, of course, the *rabi* season intervening between these two.

The following table shows the rainfall during each of these three periods :—

——	Actual.	Normal.
1	2	3
Last half of kharif, 1915.		
July 1915	40·74	23·11
August 1915	24·37	22·83
September 1915	14·14	18·58
October „	4·89	8·31
Total ...	84·4	72·83
Rabi, 1915-16.		
November 1915	0·19	1·31
December „	...	0·56
January 1916	0·67	0·75
February „	0·30	1·46
Total ...	1·16	4·08

——	Actual.	Normal.
1	2	3
First-half of kharif, 1916.		
March 1916	10·79	8·80
April „	20·15	18·72
May „	16·14	21·19
June „	14·17	31·40
Total ...	61·25	80·16
Total for the year ...	146·55	157·07

The *kharif* season of 1915 opened with heavy rainfall which led to two successive floods—the first a moderately high one, which occurred early in June and did considerable damage to the crops, both experimental and non-experimental, and another a month later which wiped out almost all the crops on the farm. The only crop that survived the floods was jute. The experimental rice plots were totally wrecked. A little of the non-experimental rice remained and was very useful as providing seedlings for a considerable area of land, where the crop had been destroyed.

The floods, however, retired quickly and the weather during the remainder of the season turned out exceptionally favourable, the only defect being a somewhat deficient rainfall in October, which slightly reduced the yield of the winter rice crop.

The *rabi* season of 1915-16 was very dry, and the potato and *khesari* crops suffered somewhat from want of rain.

The present *kharif* season 1916 started with a slight excess over the normal rainfall in March and April. In May and June there was a shortage which checked growth considerably; however, the early crops on the farm have since got over the trying time, and most of them are now looking fairly well.

Rice breeding.

5. Rice breeding continues the main work of the station. The lines on which the experiment is being conducted were settled in May 1914 in consultation with the Deputy Director, Mr. A. G. Birt, and Mr. G. P. Hector, the Economic Botanist of Bengal.

Ordinary rice seed is usually found on examination to be a mixture of different types of unequal quality and productive power. Some of these types are pure, and therefore, breed true; others are the products of natural crossing and split into types differing in character and are consequently unreliable. The types also differ in regard to their productive power and other characters.

The method of breeding followed on the farm starts by growing in the first season from ordinary village seed, as many local varieties of rice of each class as we can procure, and in picking out from each as many distinct types as we can detect while the crop is still standing in the field, each type being represented by the ripe ears taken from a single plant.

The next step is to grow the various lots of seed thus obtained in small plots side by side, first with the object of testing which of these types are constant, and therefore pure, and which again split as the result of previous crossing, and secondly, with the object of comparing the pure types in regard to yielding power and other characters. Though the rice flower is normally self-fertilised a certain amount of natural crossing is known to occur. A clear space of 3 to 6 feet around each plot is kept in order to minimise the risk of inter-crossing between adjacent types.

The next and third step is to take the pure types and grow them a second or even a third time (which is to be the work of the third or fourth season) in order to confirm the results of the second season as to their respective merits.

In this way at the end of the third or fourth season, we should be able to fix upon one or more of these pure lines, as being more prolific and of better quality all round than the rest within their own class. The next and last step will be to propagate these selected pure lines on a field scale for the purpose of distributing the produce as seed.

The experiment was commenced in 1913-14 with four classes of rice, namely, (1) early *aus* rice, which is usually grown broadcast and of which two crops may be taken in the course of a year, (2) transplanted *aus*, (3) *sail* or winter rice, (4) *asra*, which comprises the comparatively short-stemmed varieties of *amon* or swamp winter rice, and which is capable of being grown either broadcast or transplanted.

The floods of 1915 destroyed all work done up to that time with transplanted *aus*, *sail* and *asra*, and the selection work with regard to these classes needs to be undertaken *de novo*. It has, however, been decided to restrict the work for some years to come to (1) early *aus* which was spared by the floods and (3) *sail* transplanted winter rice which forms the most important class of rice grown in the country.

Below is noted the work done during the year under report on these two classes of rice.

Early aus.—This class comprises three sub-classes of rice, *viz.*, *murali*, *chengri* and *dumai*. These differ from each other in regard to the depth of water which they can stand during the later stages of growth and the time they take from sowing to harvest. A total of 161 distinct types was obtained by the selection work done in 1914. Out of these, 61 were obtained early enough to permit of their being sown again in September of that year. The resulting plants were examined as to purity and three types were rejected as unsuitable for further work. Early in 1915 these types were sown again but were destroyed by the July flood of that year. Fortunately, however, duplicate halves of the seed of 57 of these types had been kept in reserve, as a precaution against the accidental loss of the stock and with this seed the work was continued in the year under review. These 57 types of early *aus* were sown in September and reaped in December, and as was to be expected, the yields varied within very wide limits. From the seed thus obtained three further series of plots have been sown in May, the present year's crop being the third generation from the first selected types. Full records are being kept of the dates of sowing, flowering and harvesting of each type and of its yield of grain and straw. These particulars, together with a description of the characters of each type are kept in a register of pure line cultures on the farm. The yields from the pure line plots sown this season will not be available for some months to come. Although the results to be obtained this year should give some idea of the relative merits of the types under trial, it will probably be necessary to continue the course of testing for another year or two in order to obtain a clear indication as to which are the most desirable types.

Sail.—This is the most important class of rice in Assam. As the result of the previous year's work, 580 types were separated and these had just been sown in seed beds when the great flood of July came and destroyed them all. For the purpose of making the primary selection of types for a fresh start, seeds of 148 varieties of this class of rice have been collected, mostly from different parts of the Sylhet district, a few being obtained from the Sibsagar district, and some being the produce of the farm itself. On receipt of these varieties of *sail*, each was described in detail and all particulars entered on the "Register of Type selection of *sail* rice" kept on the farm.

The seeds have since been sown, and the produce will be selected and its characters recorded in the same way as this work is being done for the *aus* rice above mentioned.

A new line of selection—intra-varietal selection has been recommended by Mr. Hector, Economic Botanist of Bengal, and incorporated in the Cropping Programme for the present season. *Lati-sail*, as representing one of the most productive varieties of *sail* rice, has been selected as a basis for this work.

The main points of the work will be :—

(1) To grow this productive variety of rice under favourable conditions.

(2) To pick out at random a number of plants of one type and arrange them in the order of their productiveness, as shown by the weights or number of grains produced by each.

(3) To preserve the seeds from each plant separately, and use them as pure lines and compare the yields obtained.

Minor experiments.

6. The experiments carried out on a small scale included the following :—

(1) New varieties of potatoes from Shillong. This was a repetition of the experiments made in the preceding year 1914-15. Three different kinds of seed were contrasted with one another, *viz.* :—

King of Potatoes grown on the Shillong Farm.

King of Potatoes grown on *jhum* land in the Khasi Hills.

Country seed obtained from the South Sylhet subdivision.

The total area planted was ·3 acre which was divided into nine equal plots distributed equally among the three varieties. The crop was manured with cowdung and rape-cake, the rates being 150 maunds and 10 maunds per acre, respectively. All the varieties were planted on the same date in the beginning of November. The Shillong seed, particularly the seed grown on the Shillong Farm, did not germinate evenly and much was lost through rotting, but the blanks were filled up from time to time. The country seed germinated fairly well. The season proved very dry and although the crop was watered twice, the soil did not receive enough moisture to grow a full crop. The soil, too, was not particularly suitable, not being sufficiently light and friable to suit a root crop like potatoes. The outturn of the crop was in consequence very poor. It was as follows :—

	Yields per acre.	
	Mds.	Srs.
King of Potatoes from Shillong Farm ...	26	1
King of Potatoes *jhum* grown	48	28
Country seed	20	4

In spite of defective germination and poor yields, the Shillong variety, especially the lot which had come from *jhum* land, showed a striking superiority to the country potato.

(2) Bonemeal as manure for double crop rice land *versus* no manure.

Bonemeal was used at two different rates, *viz.* :—

(1) at three maunds per acre on 4 out of 8 plots, the remaining 4 being left unmanured.

(2) at six maunds per acre on 3 out of 6 plots, the other three remaining unmanured.

Two crops of rice were to be taken, but the first crop which was *aus* was completely ruined by the flood. The second crop grew extraordinarily well, as the land had received a fairly thick deposit of silt which made the soil extra rich.

The aggregate area of the plots to which bonemeal was applied at three maunds per acre was ⅔ of an acre and the average yield of paddy per acre was as follows :—

	Mds.	Srs.
Bonemeal 3 mds. per acre	39	39
No manure	36	23

The increase obtained from the use of bonemeal was three maunds 16 seers per acre, valued at about Rs. 5 against an expenditure of about Rs. 10-8-0 for the manure.

In the experiments with six maunds of bonemeal applied per acre, there were 6 plots having an aggregate area of half an acre.

The yields were—

	Mds.	Srs.
Bonemeal 6 mds. per acre	37	38
No manure	38	31

Here the manure though applied in a much heavier dose, failed to show any effect whatever.

It is well known that under certain conditions which are still obscure, bonemeal exerts a depressing effect on crop yields. This has been noticed at Jorhat and is a frequent experience in Bengal

The failure of bonemeal in the second experiment may be due to a similar cause. If used in combination with a large amount of organic matter bonemeal may prove useful and paying, but this remains to be seen.

(3) Green manuring with cowpea and *dhainche* for rice crop *versus* no manure. There were 12 plots having an aggregate area of exactly one acre, four of which were manured with a green crop of *dhainche* grown on the land, four similarly with cowpea, and four were left unmanured. The *dhainche* crop grew well throughout. The cowpea suffered from excessive rain and waterlogging, and made anything but a healthy growth. The yields of rice per acre have been as follows :—

	Mds.	Srs.
Dhainche ploughed in	35	37
Cowpea „	33	29
No manure „	30	13

An increase of 5 maunds 24 seers due to green manuring with *dhainche* may be considered satisfactory. The effect of green manuring with cowpea is less decided. This experiment is being repeated in the present year.

(4) A variety experiment in jute, three varieties were tested against one another, namely, a pure line bred by Mr. R. S. Finlow, the Fibre Expert of Bengal, a local variety and a variety obtained from the Goalpara district.

There were six plots of $\frac{1}{10}$ acre each, two being placed under each variety. The outturn of fibre was as follows :—

Plot No.	Mr. Finlow's.		Goalpara.		Local variety.	
	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.
1	...		...		1	30
2	2	28	...		...	
3	...		1	19	...	
4	...		...		1	9
5	2	10	...		...	
6	...		2	30	...	
Total yield from $\frac{1}{5}$ acre	4	38	4	9	2	39
Yield per acre	24	30	21	5	14	35

The great variations in yield between duplicate plots under the same variety indicate the uneven quality of the soil in the different plots. Mr. Finlow's variety has given the highest yield, and there can be no doubt that it is much superior to the local variety in respect of productiveness though its superiority to the Goalpara variety is not so certain.

The experiment is being repeated on a larger scale this year.

(5) *Specific Gravity selection of paddy seed.*—An experiment to test the method of selecting *aus* rice seed by specific gravity, *i.e.*, by immersing the seed in saturated brine, and using only those grains which are found to sink, was commenced in the rains of 1915. The crop started well but was totally destroyed by the floods of June and July following. A similar experiment is being carried out this season, but the results will not be available for some time.

(6) Jowar *as fodder.*—*Jowar* was tried both as a rains crop and as a cold weather crop. The seed of the rains crop was obtained from Bengal. It was sown on almost half an acre in April. The germination was fairly good, but the crop was almost wholly destroyed by excessive rain and flood. Seed for the cold weather crop was procured from the Central Provinces. There were two varieties, one meant for fodder and the other used for food. The total area sown was two-fifths of an acre. The seed, in neither case, germinated properly, and the crop was in consequence very thin. Individual plants, however, grew well, and produced fine heads of grain which have been saved for seed.

(7) *Mr. Hector's improved rices against country varieties.*—Mr. Hector gave us for trial one maund of seed of each of three varieties of rice selected by him. These are named *indursail*, *lambachikan* and *kandulia.* They were tested against two of the most prolific country varieties known in the neighbourhood, namely, *terabali* and *latisail.* Some time after sending the seed, Mr. Hector wrote to advise us not to sow it, as the last two kinds had been somewhat injured in the seed store. Before the receipt of this advice, the seed of all three varieties had been sown and although the germination was tardy the seedlings grew well.

The experiment was made at three different places on the farm. The total area under the five varieties was 2·45 acres divided into 31 plots, of which 7 bore *indursail*, 7 *lambachikan*, 7 *kandulia*, 7 *latisail* and 3 *terabali.*

The yields per acre were :—

	Field B.		Field E.		Field D.	
	Mds.	Srs.	Mds.	Srs.	Mds.	Srs.
Indursail	33	36	32	33	27	13
Lambachikan	31	37	27	24	28	4
Kandulia	34	36	27	4	21	38
Latisail	28	38	30	7	31	2
Terabali	...		33	36	...	

In Field B, as far as possible, the seedlings were planted singly and about 12 inches apart, which is the method that has been adopted for some years with these Dacca rices. Here Mr. Hector's varieties have done remarkably well. In Field D, the Dacca varieties fell behind *latisail* rice, but in this case seedlings of the former had suffered from the great flood of July, and although they looked apparently sound, it is possible that their productive power had been impaired by the flood. In Field E, *indursail* came midway between the two local varieties and the other two Dacca varieties compared unfavourably with the latter.

On the whole Mr. Hector's varieties, particularly the one named *indursail*, are quite promising. It is to be expected that these varieties, now that they have been acclimatised, will compare more favourably with the local kinds in next and succeeding years, and one, at least, may excel the latter in production.

The seed of these new varieties has been saved with great care, and they are being again tested during the current year.

Some of the neighbouring cultivators who have noticed these crops on the farm have been favourably impressed by the new varieties, and have inquired for the seed. A demand is likely to arise for it as soon as any seed is available.

(8) *Ground limestone experiments.*—Some ground limestone was supplied gratis by the Sylhet Ground Limestone Company for experimental purposes during the year.

A dressing of ground limestone at the rate of ten maunds per acre was given to *dhaincha* and *cowpeas* grown as green manure for paddy and to *jowar* grown as a fodder crop. In all cases the superiority of the limed over the unlimed sections was easily noticeable. In the case of the green cropped land, the effect of the limestone will be tested by weighing the produce of the rice crop, which has since been planted on these plots.

The effect of the crushed limestone on *jowar* has been very marked, the plants in many places being two feet higher on the limed than on the unlimed plots. Comparative weighings will be made when the crop has completed its growth.

Non-experimental crops.

7. A large area of non-experimental rice was grown during the year. Together with the experimental rice, it covered almost the entire area of the cultivated portion of the farm, the balance being occupied by small areas of *kalai*, *khesari*, sugarcane and potatoes.

The total yield from each crop including the experimental rice was as follows :—

—	Approximate area.	Total yield.		Yield per acre.	
1	2	3		4	
	Acres.	Mds.	Srs.	Mds.	Srs.
Rice	52·64	1,306	6	24	8
Kalai pulse (Phaseolus Roxburghii) ...	3 3	33	5	10	1
Khesari pulse	1·5	0	23	...	
Potatoes	·55	18	22	33	29

N. B.—1 maund =40 seers =$82\frac{2}{7}$ lbs.

The sugarcane crop occupies $\frac{1}{10}$ acre and is represented by three varieties—all imported from Jorhat Farm, *viz.*, B 147, B 376 and Striped Mauritius. These have proved to be the three best among the many varieties tried at Jorhat. The object of importing these was to propagate them with a view to furnish a supply of cuttings for demonstration work in the Surma Valley. The crop was greatly spoiled by water-logging in the beginning and later on by flood water which stood for several weeks on the land. It was given up for lost, but as soon as the flood subsided the crop began to make fresh growth and the blanched appearance which it had acquired soon disappeared. The crop on the whole has grown fairly well, and might have been a bumper one but for the excessive rain and floods of the year.

Cuttings were obtained in May for distribution to cultivators in the district. The sugarcane is now growing satisfactorily as a ratoon crop, and further cuttings will be available for distribution in the coming year.

Insect pests.

8. A serious plague of swarming caterpillars appeared on the subsidence of the flood about the latter part of August and invaded many parts of the Sylhet and Cachar districts. The caterpillars began by attacking the *sail* rice seedlings in the seed beds and thence spread to the transplanted crop. The plague appeared on the farm, and did considerable damage to the rice seedlings. It also appeared among the transplanted rice. The Entomological Assistant visited the farm at the time, and prompt measures taken under his direction were successful in checking the ravages of the pest. These consisted mainly in sweeping up the caterpillars, by dragging a common fishing net of fine mesh over the crop, and in destroying the chrysalids, of which an enormous number was found hiding under the grass on the ridges round the rice-fields, by scraping up the earth to the depth of about an inch and throwing it into the water. The insect disappeared for a time, but as was anticipated, a second brood appeared about the latter part of September, but timely measures prevented it from doing any appreciable injury to the rice crop, although the insects spread over a much larger area this time than was the case with the first brood. The second brood also appeared in many parts of the Sylhet and Cachar districts, but either the weather conditions were not so favourable as at the time when the first brood appeared, or because the insect itself became parasitized, the second brood was much less numerous than the first and did comparatively little damage.

The measures taken on the farm to destroy the second brood which affected only the transplanted *asra*, consisted in hand-picking, in dragging a rope over the crop at frequent intervals with a view to disturb and worry the insects, and in shaking off the caterpillars, by means of a stick, into the water on which a little kerosine oil had been poured. The cost of these operations amounted to Rs. 23-6-6 which included the cost of three tins of kerosine oil. At the instance of the Deputy Commissioner, Mr. Basu wrote a leaflet on the pest in Bengali and had it circulated in the affected areas through the local authorities.

Another insect pest, the rice bug, locally called *Mowa,* did great damage to the *aus* rice crop about the end of September and the early part of October. It was also reported from many parts of the district. On the farm about an acre and half of *aus* rice which had grown exceedingly well was utterly ruined by the pest. The crop was cut down and used as fodder.

Receipts and expenditure.

9. The receipts during the year amounted to Rs. 3,100 derived mostly from the sale of paddy. In addition there were balances of paddy and *kalai* at the end of the agricultural year worth Rs. 528 making the total income for the year Rs. 3,628.

The total expenditure was Rs. 7,336-4-0 and was distributed as follows :—

	Rs.	a.	p.
Establishment	1,691	13	10
Petty construction including fencing, roads, bridges, etc.	356	6	6
Cost of land	20	8	0
Reclamation	211	14	6
Feed of cattle	512	3	10½
Seeds, plants and manures ...	94	8	3
Wages of labourers	2,773	12	4½
Petty repairs	1,049	13	9
Service postage stamps and telegrams	37	8	0
Unspecified charges	587	11	0
Total ...	7,336	4	0

A larger amount than in the previous year has been spent under the head of "Petty Repairs," on account of the larger number of houses now in existence, and of the damage sustained by some of the buildings from excessive rain in the beginning of the agricultural year. Towards the close of the year further serious damage was caused to the buildings, both temporary and permanent, by heavy wind storms and the expenditure was still further increased thereby.

The reclamation work consisted mainly in making new drains and in removing a thick deposit of silt from the existing drains. The earth was utilised in raising the level of the roads in places where they happened to be too low.

Staff.

10. The sanctioned establishment of the farm consists of :—

	Rs.
1 Farm Superintendent on ...	100—10—200
1 Assistant Farm Superintendent...	25—1-8—40 + Rs. 10 local allowance.
1 Farm Clerk on	25—1-8—40
1 Peon	8

Besides this, there is sanction for the entertainment of four apprentices annually for a term of two years. These men are to be trained for eventual employment as Demonstrators.

The Farm Superintendent, Babu Rukmini Mohan De, has been absent on medical leave since 5th July 1915. The leave which was for six months expired on 4th January. His case is now under consideration. He is likely to be invalided.

Srijut Lalit Mohan Das, who received his agricultural education in France, has been working since 9th January last as a Temporary Agricultural Officer *vice* Babu Rukmini Mohan De. Mr. Das is being trained on the farm with a view to employment as an Agricultural Inspector.

Since 5th July when Rukmini Babu went on leave, the charge of the farm has been held by Babu Surendra Nath Gupta. His name, however, is borne on the list of Agricultural Inspectors, his substantive post being Agricultural Inspector, Karimganj and Cachar. He is at present exclusively employed on the farm.

The post of Overseer (now designated Assistant Farm Superintendent), which was vacant since 15th June 1915, is now being filled up by the appointment of Srijut Nabin Chandra Barua. He has been promoted from the post of Demonstrator in the Assam Valley to this position. The post of Farm Clerk was held during the year by Babu Prafulla Chandra Datta. He has been awarded a scholarship at Sabour, and has recently gone to pursue his studies there. Babu Nirod Behari Sarma who was formerly Farm Clerk has been re-appointed to that position. He was sent to Sabour in the previous year, but through temporary ill-health was unable to complete his course.

At the close of the year there were six apprentices under training on the farm, and three more will be appointed in April next to take the places of the three who, by that time, will have completed their course of training. One of the apprentices—Girindra Kumar De—was appointed a Demonstrator in August last after little more than one year's training.

The materials for this report were collected, and the report itself was practically all written, by Rai Bahadur B. C. Basu, Special Officer, Agricultural Department, prior to his retirement at the middle of May 1916.

SHILLONG,
The 5th August 1916.

J. W. McKAY,

Deputy Director of Agriculture,
Surma Valley.

ANNUAL REPORT OF THE KAMRUP SUGARCANE EXPERIMENT STATION FOR THE YEAR ENDING THE 30TH JUNE 1916.

Introductory.—The objects and scope of this experiment were clearly set out in paragraph 1 of the report for 1914.* For reasons explained therein it was proposed to take up 1,000 acres more or less, reclaim it and grow cane on it. On account of unforeseen delays and circumstances this has proved beyond our power, and the area reclaimed and under cultivation at the time of writing is 6 blocks of 62½ acres each or 375 acres in all, of which some 250-270 acres are now under cane.

As explained in the second report of this station,† the first year's work was preliminary to the experiment proper, and consisted in planting out some 23 acres of cane with material brought from the Jorhat Farm, to provide planting sets for the first year's experimental work which commenced in December 1914.

Last year's report therefore dealt with the preliminary crop planted in March—April 1914, and with the operations appertaining to the first year of the experiment proper, but covering only the preparation of the land, the planting of the cane and its subsequent cultivation up to the end of June 1915. The present report deals with the subsequent development of that crop, which was harvested in February—March 1916 (providing planting material for a much larger area which was planted out at that time), and also with the operations appertaining to this the second year of the experiment proper, covering the preparation of the land, the planting of the crop now on the ground, and its subsequent cultivation and behaviour up to the end of June 1916.

2. *Land.*—As explained in last year's report and for the reasons therein given, the present site of the experiment is not the one initially chosen, but lies some two miles north of it, and at a higher level. In spite of this, the very heavy rainfall of May—July 1915 told against the crop, and much of the germinated cane

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* Annual Report of the Kamrup Sugarcane Experiment Station, year ending June 30th, 1914.

† Annual Report of the Kamrup Sugarcane Experiment Station, year ending June 30th, 1915.

on the lower lying parts was killed out quite early in consequence, and before proper drainage measures could be taken. It became clearly evident that drainage was the very essence of the problem of successful cane cultivation in this tract. Experience throughout has confirmed this, and the crop which is now on the ground owes its present excellence very largely to the fact that the land was this year thoroughly drained, previous to planting, with a ditcher operated by the steam tackle, and only obtained last cold weather. Judging from the crop now growing up, one is justified in saying that with the drainage measures, now at our command, first-class crops of cane can be expected in this tract. Occasional swamp areas are to be found which are more difficult to deal with, and would not be planted in practice. Details in regard to the drainage scheme undertaken will be found later in this report, paragraph 11.

3. *Rainfall.*—Records of rainfall have been kept on the Farm since January 1915; the following figures are for the Agricultural year ending June 30th, 1916:—

		Inches.
July	1915	32·90
August	„	23·22
September	„	4·85
October	„	2·21
November	„	0·21
December	„	Nil.
January	1916	0·76
February	„	1·33
March	„	4·83
April	„	11·73
May	„	23·52
June	„	8·93
Total		114·49

The rainfall from 1st January—30th June 1915 was 49·36 inches. This year, 1916, the fall for the corresponding period was 51·1 inches, thus exceeding the total for last year up to the end of June by 2 inches. It is further evidence therefore in favour of the efficacy of the drainage work undertaken, that this year, in spite of a rather greater rainfall up to the end of June, the cane has not only not died out in any part, but has steadily maintained a very good rate of growth. Last year the cane which survived practically marked time during the rainy months; this year practically the whole area is progressing normally and well.

4. *Soil.*—The soil of the high land varies from good loam to sandy loam on a sandy sub-soil. In a few places the sand comes to the surface, but usually there is from 1 to 3 feet of good soil, while in the swamps the soil is stiff on a stiff sub-soil, although it is probable that sand exists at no great depth. Except on the few sandy patches the soil is dark brown or black in colour, denoting good supplies of organic matter. On the whole, the soil is a good loam, easily worked, and very suitable for cultivation. The soil is well adapted to the climate; the annual rainfall being high and well-distributed demands a light free draining soil such as exists here. Judging by the growth of other crops, *e.g.*, soybeans, cowpeas, dhaincha, jowar, oats, etc., on the farm, the present fertility is high, and except on some of the very lowest-lying parts, which before reclamation and drainage by us have probably been swampy for generations, there is no evidence of any toxic action: moreover, on these lower areas the toxic factor apparently rapidly disappears after drainage. The evidence of fertility as shown by the growth of many and diverse crops confirms some soil analyses made personally by me some 3 years ago on samples taken from an adjoining tract.

5. *Communications.*—The site is approached from Nalbari Station, Eastern Bengal Railway, by a public road northward to Garbhitar village, some 10 miles, where a village tract leading to Khagrabarigaon has been widened out and made into a carting road, and extended to the present farm site, which is 7 miles from Garbhitar.

6. *Buildings, fencing, etc.*—The buildings consist of a Manager's bungalow, coolie lines, cattle shed, godown, smithy, etc. The bungalow was finished in July 1915. Heavy wind storms necessitated the re-erection of part of the coolie lines and the godown. For completing the fencing of the extension area, 1½ miles of wire fencing was purchased at a cost of Rs. 1,500 and the whole farm is now enclosed.

7. *Cattle.*—The 10 pairs of bullocks purchased 2½ years ago have been steadily employed for carting purposes. At present many of them are suffering from foot-and-mouth disease, but normally they keep in excellent condition.

8. *Water-supply.*—Norton tube wells are being used with great success, and an excellent supply of water is obtainable for drinking purposes all the year round. These wells also distributed over the cane area, provide water for the engines.

In addition a permanent running stream close by the coolie lines supplies water for washing purposes, etc.

9. *Labour.*—Most of our coolies are imported from Ranchi, being recruited personally by the Manager, with the permission of the Bihar and Orissa Government, on a 6-monthly system; this has proved a very satisfactory arrangement, and many of the coolies so recruited are settling down here on the expiry of their term. The Manager with his previous experience of recruiting finds no difficulty in getting all the labour required from this source; he reports that very much more could easily be obtained. Our experience leads us to suppose that, if a Central Factory started work in this tract, ample labour could be obtained from the same source. We find that much dependance cannot be placed on the local (Kachari) labour at any time.

10. *Cultivating tackle.*—This comprises :—

2 Steam tractors, compound engines.
1 Five furrow plough, double ended.
1 Harrow.
1 Cultivator.
1 Roller.
1 Ridger.
1 Leveller.
1 Ditcher.

The Ditcher was imported during the year through Messrs. John Fowler at a total cost of Rs. 4,450. It makes a drain approximately 3 feet wide at top, 2 feet deep and 1½ feet wide at bottom, and saves infinite labour.

A motor plough, costing Rs. 3,000, for cultivation between the rows of standing cane, has not proved of much use to date, owing to the rough state of our land at present, and to the fact that the cane is planted in trenches. With planting on the flat, now indicated as desirable on other grounds, it may prove useful for intercultivation.

11. *Drainage Scheme.*—It has been observed that the land is not level, shallow drainage channels of varying width occurring at intervals. Thus a proportion of the area is liable to be more or less flooded in times of very heavy rain. The damage by flooding which took place last year was due to outside water

flooding certain parts, and to the rise of the sub-soil water to within 2 feet of the surface. The problem presented to us was how to keep out the outside water, and to lower the water table sufficiently to prevent drowning of the cane on the lower areas in addition to ensuring its growth throughout the wettest months.

The broad lines of the drainage scheme were settled in January 1916 in consultation with Mr. Milligan, Imperial Agriculturist, to meet the above conditions.

The scheme was roughly as follows, the fall of the land being from north to south :—

A big drain protecting practically 3 sides of the area, 9 feet wide at top 3 feet deep and 6 feet wide at bottom, was dug outside the area. The capacity of this was further increased by excavating a subsidiary drain 2 feet wide × 2 feet deep, at the bottom of the large one where possible. In places the depth of excavation was much greater than is indicated above owing to irregularities in surface level. The earth removed from the drain was all placed on the near side of the latter, thus providing a bund as protection against outside water and serving as a road.

Between the 60 acres blocks large mains about 6 feet wide by 3 feet deep were dug running north and south. The 60 acres blocks are sub-divided by cross roads into four equal areas of 15 acres, each with an independent drainage system.

In these areas, to deal with the rise of sub-soil water and surface accumulations, drains were dug by the Ditcher 65 feet apart and parallel with the cane rows running north and south, and further drains were provided running east and west at the head and foot of each, these leading into the mains. These measures were all taken previous to planting out the cane.

It was subsequently found necessary to put in a few extra drains in the lower lying parts, running east and west across the general drainage lines. Up to the time of writing, the above scheme, imperfectly described, has proved satisfactory.

12. *Cane planted in April and May* 1915.—Refer paragraph 13 of last year's report. As therein stated some 70 acres in all were planted up. Planting was late, quite unavoidably, and the very heavy and continuous rain of the three months following planting seriously checked the growth of the cane, and in the lower lying areas killed it out in patches. In the light of the present year's experience it is safe to say that this would not have occurred had it been possible to drain the blocks before planting. The cultivation and behaviour of this crop up to the end of June 1915 is described in paragraph 13 of last year's report. It only

remains to outline its subsequent progress. Rainfall continued to be very heavy up to the middle of August. Thereafter it fell off considerably, and from mid August the surviving cane, which had practically marked time up to then, grew very rapidly and tillered enormously giving a big average of canes per clump. The crop continued to grow well up to harvest time and presented a remarkably healthy appearance. In spite of this it never quite recovered the ground it lost during the wettest period from May to mid August 1915, and did not properly mature its canes, though providing very excellent material for planting in the spring of the current year. In view of what had been said, it was not considered of any use weighing this crop. Of the 70 acres originally planted some 40 acres only carried through, and provided planting material for 230 acres this year.

13. *Extension area. Season* 1915-16.—A level survey was made towards the end of the year, and some 4 blocks comprising 250 acres were reclaimed commencing early in October 1915. The operations consisted of the harrowing down of grass jungle previous to burning off; ploughing which was finished by end of December 1915; harrowing, cultivating twice followed by harrowing and rolling, draining, and trenching for planting. Each block was divided up by cross roads at right angles into 4 areas 15 acres each.

14. *Planting of present crop.*—Planting commenced mid February and was finished by the end of March 1916. Thus planting had been finished this year by the time it commenced the previous year. With the exception of one block, which was reserved for an experiment in methods of planting, the same way of planting as was observed last year was followed. The vacancies occurring in the blocks planted up last year were filled in, amounting to some 30 acres planted in all.

Further 200 acres new planting was done making a total of 230 acres newly-planted cane (with 40 acres ratoons, this gives us 270 acres in all under cane this year).

The block reserved for experiments in planting methods was No. IV, comprising four 15 acres plots (*a*), (*b*), (*c*) and (*d*).

Details were as follows :—

Plot (*a*) Cane rows 4½ feet apart on flat.
„ (*b*) Ditto 4½ ditto in trenches.
„ (*c*) Ditto 3 ditto on flat.
„ (*d*) Ditto 5 ditto on ridges, rolled down.

Germination was good nearly all over, and the subsequent growth of the crop has been most satisfactory up to the time of writing, the earlier planted blocks being however clearly in advance of the later ones. Owing to the drainage scheme put down, and to earlier planting, the condition of affairs this year is incomparably superior to that of the past season. Not only has the cane not died out in any part, but it has continued its growth normally to date. The present prospects of a good crop at harvest are most favourable.

The cultivation given to the end of June was, for plant cane, one hoeing and two weedings, and for the Ratoon crop 2 hoeings and 2 weedings, with the result that the cane at present is clean and in good cultivation.

The varieties under cultivation are as last year, Striped Mauritius, Barbadoes 147 and 376.

15. *Cane Nursery.*—The following varieties are being grown in the nursery for trial later :—

(*a*)	Red Sport of Striped Mauritius.	
(*b*)	Barbadoes	1529.
(*c*)	„	B (number uncertain).
(*d*)	„	A (ditto).
(*e*)	„	6450.
(*f*)	„	3412.
(*g*)	Java	247.
(*h*)	„	33*a*.

Some of these are showing promise.

16. *Other crops.*—The following crops were grown :—

Rains crops.—Dhaincha. Jowar.

Rabi crops.—Oats. Mustard.

Dhaincha was grown for seed ; it was sown very late and much too thick as it turned out. It grew fairly well nevertheless, and provided all the seed required for the current year's green manuring.

Jowar grew very luxuriantly ; this is a gross feeder, and its magnificent growth here emphasizes the fertility of this soil. One acre was put down ; part was fed off and the remainder left to mature, over 17 maunds seed being harvested.

Oats and mustard grew well, but threshed out poorly. It was impossible to give the land the necessary cultivation before sowing. The absence of rolling in particular robbed the crops of moisture at a critical time in their growing period.

Rains crops, 1916.

Dhaincha.—70 acres Dhaincha for green-manure and seed.
Cowpeas.—5 acres for seed.
Both are doing well.

17.—*Expenditure*—

Heads.	Amount spent from 1st July 1915 to 31st March 1916.			Amount spent from 1st April 1916 to 30th June 1916.			Total.			Remarks.
1	2			3			4			5
I.—Establishment—	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	
Manager	7,200	0	0	2,400	0	0	9.600	0	0	
Clerk	450	0	0	150	0	0	600	0	0	
Tackle assistants ...	1,352	0	0	582	0	0	1,934	0	0	
Peon	270	0	0	90	0	0	360	0	0	
Total ...	9,272	0	0	3,222	0	0	12,494	0	0	
II.—Special Contingencies—										
Machinery and implements.	4,730	4	6	...			4,730	4	6	
Fencing	145	0	0	1,500	0	0	1,645	0	0	
Books, maps, etc. ...	10	9	0	...			10	9	0	
Total ...	4,885	13	6	1,500	0	0	6,385	13	6	
III.—Regular Contingencies—										
Feed of cattle ...	246	0	0	...			246	0	0	
Seeds, plants and manure	37	11	9	...			37	11	9	
Wages of labourers ...	13,470	10	0	6,809	10	9	20,280	4	9	
Petty repairs ...	544	7	3	130	1	6	674	8	9	
Service postage ...	50	0	0	...			50	0	0	
Fuel	2,369	12	6	2,172	14	0	4,542	10	6	
Stores, oil, etc. ...	951	5	6	36	4	0	987	9	6	
Miscellaneous ...	1,010	3	0	82	0	6	1,092	3	6	
Total ...	18,680	2	0	9,230	14	9	27,911	0	9	

Heads.	Amount spent from 1st July 1915 to 31st March 1916.	Amount spent from 1st April 1916 to 30th June 1916.	Total.	Remarks.
1	2	3	4	5
	Rs. a. p.	Rs. a. p.	Rs. a. p.	
Petty Constructions—				
Buildings	200 0 0	...	200 0 0	
Roads	1,500 0 0	...	1,500 0 0	
Total ...	1,700 0 0	...	1,700 0 0	
Grand total ...	34,537 15 6	13,952 14 9	48,490 14 3	

18. *Receipts.*—Jowar seed, etc., Rs. 54-1-6.

19. *Staff.*—The present staff consists of :—

		Rs.	
Manager on	... ...	800	per mensem.
Clerk on	... ...	50	,, ,,
Engine Staff.	One Mistri on	50	,, ,,
	Two drivers on	20	,, ,,
	Three 2nd drivers on ...	18	,, ,,
	One Engine attendant ...	15	,, ,,
	One ploughman	20	,, ,,
	One ,, ...	15	,, ,,
Three Peons on	... ...	10	,, ,, each.

20. *General.*—The Deputy Director of Agriculture, Assam Valley, visited the Farm once a month throughout the year.

Other visitors included the Director of Land Records and Agriculture, Assam ; Mr. Milligan, Imperial Agriculturist ; Dr. Barber, Imperial Sugarcane Expert ; Hon'ble Mr. Glen and Mr. G. Young, Birkmyre Bros. ; Mr. Urmson, Kilburn & Co. ; and the Deputy Commissioner, Kamrup.

The manager continued in residence on the Farm throughout the year.

The general health has been very good.

A. A. MEGGITT,

Deputy Director of Agriculture,
Assam Valley.

KAMRUP FARM ;
The 27th July 1916.

REPORT ON AGRICULTURAL DEMONSTRATIONS IN THE ASSAM VALLEY DURING THE YEAR ENDING JUNE 30TH, 1916.

Maulvi Fazlal Haq Ahmed, Agricultural Superintendent, was in charge assisted by the Agricultural Inspectors of Sibsagar and Kamrup, with three Demonstrators in Sibsagar, and one in Kamrup. One additional Demonstrator was appointed in either district from 5th April.

2. As in the previous year demonstrations were undertaken on—

Paddy—
- (a) Manuring with bonemeal and Stane's flour Phosphate.
- (b) Green manuring for paddy.

Sugarcane—
- (a) Superior varieties.
- (b) Green-manuring for cane.
- (c) Three roller iron crushing mills.

Potatoes.—Superior varieties.

Fodder crops.—Trial of

Meston Plough.—Use of

Conservation of cattle manure.—Improved methods for

New crops.—Trial of

3. *Paddy.—Manuring with bonemeal and flour phosphate.*—Seven centres in Kamrup and 10 in Sibsagar manured with bonemeal and flour phosphate in 1913 were kept under observation for residual effect in the third year, no further manure being used.

The 1st and 2nd year's results appeared in the two previous reports. The 3rd year results of the Sibsagar Demonstrations appear in the following table :—

SIBSAGAR DISTRICT.

No.	Locality.	Grain per acre in lbs.			Remarks.
		Bonemeal plots.	Flour phosphate plots.	Untreated plots.	
1	2	3	4	5	6
1	Lakua	1,362	1,684	1,276	
2	Sibsagar ...	1,736	1,952	1,704	
3	Nazira	2,338	2,694	2,206	
4	Chikonidhora ...	1,622	1,578	1,450	
5	Kakojan... ...	1,330	1,764	1,326	
6	Charengia ...	1,858	1,312	1,344	
7	Kacharihat ...	1,644	1,610	1,622	
8	Titabar	1,736	2,700	1,438	
9	Jhanzi	1,690	1,772	1,476	
10	Dergaon... ...	1,330	1,282	1,294	

The average increase in yield of the bonemeal and flour phosphate plots over the untreated plots was thus 321 lbs. grain per acre for flour phosphate and 148 lbs. per acre for bonemeal.

Valuing the grain at Rs. 3 per maund, this gives Rs. 12 and Rs. 5-10-0 net profit per acre for the third year in the case of flour phosphate and bonemeal respectively.

Reference to previous reports will show that the total average net profit for the above ten centres for the 3 years works out at Rs. 31-3-0 for flour phosphate and Rs. 15-1-0 for bonemeal, on an initial expenditure for manures of Rs. 7-8-0 and Rs. 9, respectively.

In the Sibsagar district therefore, unlike the hill tracts, flour phosphate appears to be very much more effective as a manure for paddy than bonemeal.

The 3rd year results of the demonstrations commenced in Kamrup in 1913, are quite valueless. The plots were badly washed out by heavy floods in their first year, from the effects of which they have never recovered ; the results have been throughout most erratic.

4. *Second year demonstrations.*—These were commenced in 1914, twelve centres in Sibsagar and ten in Kamrup being laid out as bonemeal demonstrations. The first year's results appeared in the previous report. The second year's results appear in the following table :—

SIBSAGAR DISTRICT.

No.	Locality.	Grain in lbs. per acre.		Remarks.
		Bonemeal plots.	Untreated plots.	
1	2	3	4	5
1	Kanogaon	2,120	1,746	
2	Barkatonee	1,608	1,950	
3	Nahorance	1,816	1,728	
4	Kamargaon ...	2,120	1,746	
5	Charaibahi	1,174	916	
6	Hatigarh	1,540	1,290	
7	Nakachari	2,202	1,894	
8	Bogidowl	1,220	1,128	
9	Namtiali	984	1,500	Bonemeal plot damaged by Rice Hispa.
10	Amguri	1,914	1,634	
11	Suffrai	1,350	1,228	

Neglecting No. 9 in which case the bonemeal plot was badly damaged by Rice Hispa, the remaining ten centres show an average increase due to the use of bonemeal of 180 lbs. paddy grain per acre in this the second year after application, valued at Rs. 6-12-0. Last year the net profit, after deducting Rs. 9 per acre for cost of bonemeal, was Rs. 3 per acre. The total net profit for the first two years of these demonstrations therefore averages out at Rs. 9-12-0 per acre.

KAMRUP DISTRICT.

No.	Locality.	Grain per acre in lbs.		Remarks.
		Bonemeal plots.	Untreated plots.	
1	2	3	4	5
1	Rangia	1,476	1,476	
2	Septi	3,024	2,662	
3	Digaru	2,970	3,042	
4	Chankhuti	3,246	1,876	
5	Parakuchi	430	368	Damaged by flood.
6	Ajra	1,188	992	
7	Bilpar	1,258	1,106	

At centre No. 4, quite an improbable increase is registered and one moreover quite at variance with the bulk of the results obtained with bonemeal in the Kamrup district. This centre is therefore neglected. For the remaining six centres, the average increase per acre from the bonemeal plots is some 120 lbs. paddy grain, valued at Rs. 4-8. The use of bonemeal in the Kamrup district for paddy does not apparently result in that large increase in crop which is general in the hill tracts, nor are the results as good as are obtained in the Sibsagar district demonstrations up-to-date. In view of the above, in the new demonstrations commenced in 1916, *dhaincha* is being grown as a green crop after the application of bonemeal, this green crop being *ploughed* in at puddling time with a view to rendering the bonemeal more available in these soils for the subsequent paddy crop.

5. *New paddy demonstrations.*—During 1915, four new centres in Kamrup and 8 in Sibsagar were added. In each of these one plot was treated with bonemeal, rate 3 maunds per acre, the other being a check plot. The results appear below:—

SIBSAGAR DISTRICT.

No.	Locality.	Grain in lbs. per acre.		Remarks.
		Bonemeal plots.	Untreated plots.	
1	2	3	4	5
1	Kachojan	2,802	2,232	
2	Parbatiya	1,524	1,248	
3	Khangia	1,646	1,198	
4	Kakotigaon ...	1,628	1,488	
5	Chandang-gaon ...	2,496	2,448	
6	Gorakhiyadowl ...	2,396	1,678	
7	Dhai-ali	1,362	1,148	
8	Dhoporgaon ...	1,240	1,148	

Averege increase due to bonemeal is 313 lbs. paddy grain per acre, valued at Rs. 11-8. Cost of bonemeal was Rs. 9 per acre, hence the first year of these demonstrations shows an average net profit of Rs. 2-8 per acre.

KAMRUP DISTRICT.

No.	Locality.	Grain in lbs. per acre (sali).		Remarks.
		Bonemeal plots.	Untreated plots.	
1	2	3	4	5
1	Kallapara	1,160	1,020	
2	Uparsali	1,154	1,026	
3	Gobindpur	1,396	1,150	

One centre at Palasbari was damaged by floods, and has been omitted.

Average increase per acre from bonemeal plots is some 171 lbs. grain, valued at Rs. 6-8. Cost of manuring was Rs. 9 per acre, thus showing a net loss on the first year of Rs. 2-8 per acre. The profit which may be expected to accrue in the second and third years, should convert this initial loss into a net profit with lapse of time.

6. *Green manure for paddy.*—In 1915, at two centres in Kamrup and in Sibsagar, *dhaincha* was grown and ploughed in as preparation for paddy. At one of the Kamrup centres, bonemeal 3 maunds per acre was tried against the green crop.

No.	Locality.	Grain in lbs. per acre.			Remarks.
		Green manure plot.	Bonemeal plot.	Untreated plot.	
1	2	3	4	5	6
1	Timtimia (Sibsagar)...	1,980	...	1,680	
2	Sorbhog (Kamrup) ...	1,204	...	1,740	Green manure plot eaten off by cattle.
3	Nalbari („) ...	2,850	2,790	2,480	

These results are encouraging; in 2 cases out of 3 green manuring has given a substantial increase per acre, at a very small cost, not exceeding Rs. 3 per acre, for *dhaincha* seed.

Srijut Narayan Barua, Honorary correspondent, continued his paddy demonstrations, under the supervision of the Agricultural Superintendent. In the third year of a bonemeal and flour phosphate trial, he obtained 1104 lbs. paddy per acre from the bonemeal plot, as against 1,196 lbs. and 1,192 lbs. for the flour phosphate and check plots, respectively.

In another demonstration he obtained 3,310 lbs. paddy per acre by transplanting 2 seedlings in a bunch 15 inches apart, as against 3,094 lbs. with 3 seedlings in a bunch 15 inches apart, and only 1,860 lbs. when 6 to 10 seedlings are transplanted per bunch as is the local custom.

Similar results are consistently recorded by this experimenter, and go to emphasize the value of planting a smaller number of seedlings.

This correspondent has selected a variety of paddy named by him "George Sali," which consistently gives a very high yield per acre in low situations, and is being experimented with by us this year.

7. *Sugarcane varieties.*—Demonstrations of superior varieties of cane were undertaken both in Kamrup and Sibsagar, there being 5 centres in the former and 16 in the latter district. Owing to abnormal floods during the chief growing season, many of these trials were more or less ruined. In some cases also the demonstrations were badly carried out by the Demonstrators in charge. Where the demonstrations were properly conducted and floods caused no damage, the results in favour of our improved varieties and of better cultivation methods, as against the local varieties of cane and the rayots methods of cultivation, were quite outstanding, increases up to 200 per cent in the amount of *gur* per acre manufactured being recorded. The results emphasize also the fact that if we, as a Department, are to effect any large increase in the amount of *gur* per acre obtainable by the rayot, it is not sufficient merely to send out better varieties of cane; the cultivator must adopt better cultivation methods; indeed it is not too much to say that in the absence of better cultivation, we cannot hope to effect much by merely distributing better varieties. Under bad cultivation the best varieties will quickly deteriorate. The local demand for the Jorhat acclimatised varieties is very great and increasing. This year some 92,000 sets were sent out from the Jorhat Farm alone.

Srijut Thaneswar Sarma Barthakur, Thakurbari Farm, Sibsagar, Honorary Correspondent of this Department, has been experimenting with Tana canes from Jorhat against the local variety.

Careful accounts of cost of cultivation and outturn have been kept with the following satisfactory results per acre for crops harvested this year :—

—	Tana.			Local variety.
	Plant cane.	First ratoon.	Second ratoon.	Plant cane.
1	2	3	4	5
	Rs. a.	Rs. a.	Rs.	Rs. a.
Total expenditure including cost of cultivation, manuring, crushing and *gur* making, etc.	233 12	176 10	168	244 12
Outturn.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.
Weight of cane	676 10	482 35	461 10	468 35
" " juice	410 8	287 20	287 20	289 7
" " *gur*	73 20	46 34	43 20	43 5
	Rs. a.	Rs. a.	Rs. a.	Rs. a.
Price of *gur* sold at Rs. 8-8 per maund.	624 12	398 4	369 12	366 9
Net profit per acre ...	391 0	221 10	201 12	121 13

These results are so strongly in favour of the Tana cane that the Honorary Correspondent is giving up cultivating the local variety entirely.

Babu J. C. Roy, Nowgong Honorary Correspondent, also made a very successful demonstration with B-147. The canes grew to about 14 feet high and from 1 *bigha* of this variety he obtained 42 maunds of *gur*. A neighbour growing local cane got only 40 maunds *gur* from 3 *bighas*. This correspondent has generously distributed sets of B-147 to interested people in his vicinity.

Green manuring for cane.—Two centres in Kamrup and 2 in Sibsagar were green-manured in 1915 in preparation for cane, which was planted in the spring of 1916. The results will be available next year.

Three-roller iron crushing mills.—Demonstrations with these mills were continued with great success in six centres in Kamrup with the result that six mills were sold; more could have been disposed of, but were not available at the time.

In Sibsagar 4 mills were hired out at 4 annas per day for the season, and 9 mills were sent out for demonstration purposes in the district. Many more could have been sold or hired out had they been available. Co-operative credit societies could do very useful work in this connection.

8. *Potatoes.*—Demonstrations of superior varieties were made in both districts, Sibsagar and Kamrup, there being 12 centres in the former and 3 in the latter district.

In a few cases the demonstrations were spoilt owing to bad germination due to damage in transit from Shillong and to the fact that in certain centres potatoes were deliberately pilfered from the plots before harvesting.

The superior variety grown for comparison with the seed potatoes locally cultivated was "Up-to-date" from the Shillong Farm.

Kamrup District.

No.	Locality.	Varieties planted.	Yield per acre.	Value of increase at Rs. 2-8 per maund.
1	2	3	4	5
			Mds. srs.	Rs.
1	Govindpur	Up-to-date	130 23	182
		Deshi	57 26	
2	Roha ...	Up-to-date	114 0	96
		Deshi	75 25	
3	Sadilapur	Up-to-date	83 25	71
		Mixed Khasi bazar variety	55 5	

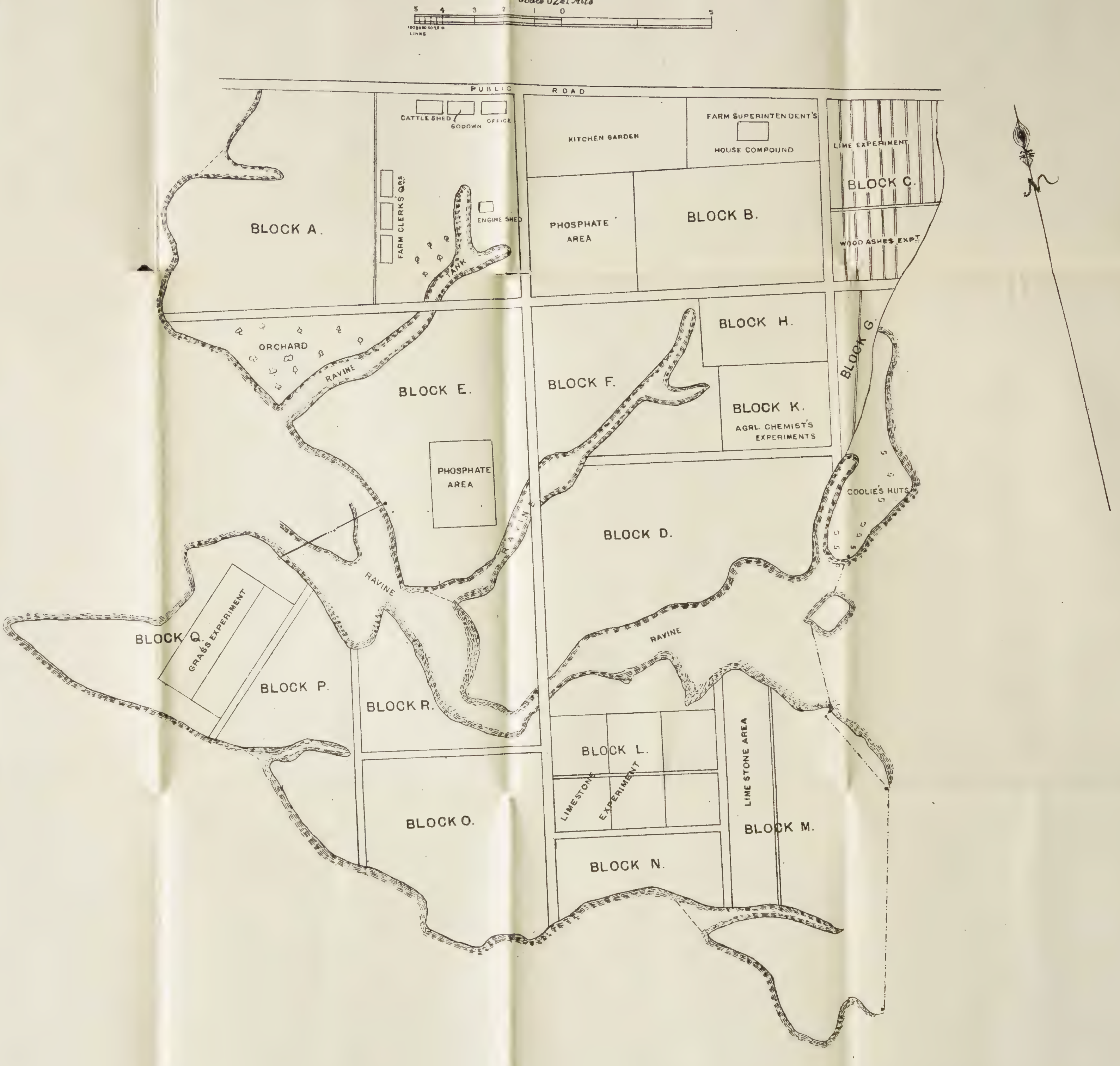
These results show a very considerable profit per acre in favour of the Up-to-date variety in every centre.

SIBSAGAR DISTRICT.

No.	Locality.	Variety.	Yield per acre.		Remarks.
1	2	3	4		5
			Mds.	srs.	
1	Nowhatia ...	Up-to-date	224	20	
		Local seed	139	36	
2	Cooly Depôt ...	Up-to-date	115	32	
		Local seed	52	38	
3	Dergaon ...	Up-to-date	93	31	The local seed was planted about a fortnight earlier.
		Local seed	148	13	
4	Malow ...	Up-to-date	73	19	
		Local seed	49	18	
5	Desangmukh ...	Up-to-date	120	0	
		Local seed	55	38	
6	Mateka ...	Up-to-date	76	22	
		Local seed	15	22	
7	Dikoomukh ...	Up-to-date	25	8	
		Local seed	22	4	
8	Kamargaon ...	Up-to-date	111	8	Local seed was planted a fortnight earlier. The Up-to-date germinated badly.
		Local seed	146	8	
9	Numligarh ...	Up-to-date	82	32	
		Local seed	72	18	

MAP
OF
JORHAT FARM

Scale 32=1 Mile



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MESSRS. K. C. HAZARIKA & Co.

JORHAT ASSAM.

2-8-1914.

D.O. Shillong R.S. No.1202 of 1916

No.	Locality.	Variety.	Yield per acre.		Remarks.
1	2	3	4		5
			Mds.	srs.	
10	Shikarighat ...	Up-to-date	45	0	
		Local seed	37	2	
11	Bokadora ...	Up-to-date	23	22	Local seed planted earlier. Departmental seed germinated badly.
		Local seed	73	32	

In the above eleven demonstrations, with the exemption of 3 centres where for reasons given in remarks column the local seed beat the Departmental seed, increases, in some cases very large, were recorded in favour of the superior varieties supplied by the Department. Taking the whole 11 centres together, the average yields per acre work out as follows :—

			Mds.	srs.
Up to date	...	...	90	7 per acre.
Local seed	...	...	73	39 per acre.

Valued at Rs 2-8 per maund, the value of the increase averages out at Rs. 40 per acre for the whole series.

This is a very satisfactory general result.

9. *Fodder crop* .—Jowar was grown for this purpose at certain centres, but unfortunately these demonstrations were ruined by floods.

Meston ploughs.—Six were sent out in both Sibsagar and Kamrup for demonstration in the villages. Many cultivators tried the plough themselves, but in many cases they profess that the draught is too great for their cattle. One plough only was sold during the year in Kamrup, against seven in the previous year. This work has not received the attention it deserves at the hands of the Demonstration Staff. The plough is much more efficient than the ordinary country implement, and is, moreover, very cheap and light.

Rai Sahib Rajani Kanta Choudhury of Sorbhog has been using Meston ploughs for the past 2 years. He informs us that in his own experience, one Meston plough does the work of two Deshi implements and results in increased crop yields.

Srijut Pithubar Saikia also uses them on his estate and speaks highly of their utility and effectiveness.

11. *Conservation of Cattle Munure.*—Model manure pits, covered in, have been erected in both Sibsagar and Kamrup districts by the Demonstrators, but the progress made is not as great as it should be.

This work suffers from the deep rooted conservatism of the cultivators ; only by constant pushing will any great improvement be possible in regard to the conservation and proper use of cowdung. Demonstrators who neglect this aspect of their work will be regarded as inefficient.

12. *Trials of new crops.*—Boro paddy, under the stimulus of Srijut P. N. Choudhury, Mauzadar of Nalbari, was tried in four centres in his mauza. One Dherkha Ram Thakhuria, member of the village union, grew the crop quite successfully. There, would appear to be an extensive field for the introduction of this type of paddy in the Assam Valley, and it is interesting to note that the demand for seed is much greater than last year.

Ground-nuts were also tried as a new crop in many places and almost everywhere were well reported on by the cultivators.

Shillong,

The 26th September 1916.

A. A. MEGGITT,

Acting Deputy Director of Agriculture, Assam Valley.

REPORT ON AGRICULTURAL DEMONSTRATIONS IN THE KHASI AND JAINTIA HILLS DISTRICT DURING THE YEAR ENDING THE 30TH JUNE 1916.

U Hari Singh, Agricultural Inspector, Khasi and Jaintia Hills, was in charge of this work, assisted by three demonstrators headquartered at Shillong, Mawphlang and Jowai, respectively.

2. *Rice.*—New demonstrations on the value of bonemeal for paddy were carried out on cultivators' land in 20 fresh centres, *i.e.*, 15 in the Khasi and 5 in the Jaintia Hills. As in previous years two plots were taken at each centre about ⅓ acre in area, one being manured with 3 maunds bonemeal per acre, the other being untreated as a check.

The first year's results are given in the following table :—

No.	Place.	Cultivator.	Yield of grain in lb. per acre.		Remarks.
			Bonemeal plots.	Untreated plots.	
1	2	3	4	5	6
1	Mawsynrie ...	Mrival ...	1,334	825	
2	Umjapung ...	Klat	1,867	1,734	
3	Umroi ...	Jamiun ...	398	300	Damaged by flood.
4	Umsohlang ...	Poet	1,805	1,481	
5	Umsaw ...	Biang	1,946	1,751	
6	Mawrong ...	Khaka Sen ...	2,054	1,932	
7	Nanglakhiat ...	Bha	1,187	797	
8	Mawshaton ...	Byrwiah ...	720	510	Damaged by flood.
9	Mawsiat Khnam ...	Kalicharon ...	1,746	1,536	

No.	Place.	Cultivator.	Yield of grain in lb. per acre.		Remarks.
			Bonemeal plots.	Untreated plots.	
1	2	3	4	5	6
10	Untkah ...	Nimor ...	2,214	2,124	
11	Rambrai ...	Hari Siem ...	746	486	Damaged by insects.
12	Nongstoin ...	Suna Siem ...	348	375	Damaged by flood.
13	Nongspung ...	Kha Silihon ...	1,500	552	
14	Nongan ...	Kir Lyngdoh ...	1,488	750	
15	Laitdom ...	Morkin ...	1,368	702	
16	Khlihtyrsli ...	Kha Manik ...	933	554	
17	Rymbai ...	Wanbareh ...	1,105	792	
18	Kyndongtubon ...	Khakaksoil ...	1,628	984	
19	Mawdymmai ...	Kha Issainh ...	1,899	870	
20	Pynthonlangtun ...	Shai Surong ...	1,476	507	

At 4 centres Nos. 3, 8, 11 and 12 the demonstrations were ruined by floods or insect pests. They are therefore neglected. Leaving them out of account, for the remaining 16 demonstrations the average yield per acre of the bonemeal plots works out at 1,596 lbs against 1,118lbs for the untreated plots. Thus the average increase over the untreated plots due to bonemeal is some 478lbs grain per acre. Valuing the grain at Rs. 3 per maund and the bonemeal at Rs. 4-8,* the bonemeal plot shows a gross profit per acre of Rs. 18 on an expenditure of Rs. 13-8, leaving a nett profit per acre of Rs. 4-8 in the first year of application. Any excess recorded in subsequent years will be pure profit, and experience proves that bonemeal favourably affects the crop for 3 or 4 years.

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* Farm ground bonemeal was used at these 20 new centres, and its average cost delivered at demonstration sites works out at Rs. 4-8 per maund approximately.

Second year demonstrations.—The 10 centres commenced in 1914, of which the first year's results appeared in last year's report, were kept under observation without further manuring and the results appear below :—

No.	Place.	Cultivator.	Yield of grain in lb per acre.		Remarks.
			Bonemeal plots.	Untreated plots,	
1	2	3	4	5	6
1	Laubyrtun	Suba Myntri	966	510	
2	Nongkasen	Rang Singh	1,224	615	
3	Pariong	Rison Singh	1,061	274	
4	Nongsynrih	Kpa U Ro	956	978	Damaged by flood.
5	Jakrem	Kourai...	1,484	975	
6	Rahaing	Khmah Spadep	1,800	1,200	
7	Nongbah	Khmied Pasie	...	...	Totally flooded out.
8	Nongjngi	Hed Doloi	720	484	Damaged by insects.
9	Wahjajer	Ket Phama	1,145	552	
10	Nartiang	U Kat	1,200	1,080	

At centres Nos. 4, 7 and 8 the demonstrations were spoilt by floods or insects and should be neglected. The remaining 7 centres show an average return of 1,270lbs grain per acre for the bonemeal plots as against 744 lbs. for the untreated plots, giving an average increase per acre in favour of the bonemeal plots of 526 lbs. grain, valued at Rs. 19-8 at current rates.

These centres showed an average net profit of Rs. 12-12 per acre in their first year, charging the cost of the bonemeal entirely to the first year's work. The total net profit per acre for the first 2 years of this series of demonstrations averages out, at Rs. 32-4, therefore, on an initial expenditure of Rs. 15 per acre.

The trial laid down in 1914 using raw Egyptian phosphate against bonemeal against no manure was continued in its second year without further manure. In the first year the Egyptian phosphate gave an increase of 150 lbs. grain per acre; in this the second year a decrease of 36 lbs. per acre was recorded for it. The plots are being observed for the third year, but it is clear that raw mineral phosphates are less effective than bonemeal under the peculiar soil and climatic conditions in the hill tracts.

Third year demonstrations.—Commenced in 1913, ten demonstrations using bonemeal *versus* Stane's flour phosphate *versus* nil were observed this year for third year residual affect. The first and second year's results appear in the reports for 1914 and 1915, respectively. The 3rd year results appear below :—

No.	Place.	Cultivator.	Yield of grain in lbs. per acre.			Remarks.
			Bonemeal plots.	Flour phosphate plots.	Untreated plots.	
1	2	3	4	5	6	7
1	Smit ...	Siem of Khyrim ...	...	...	...	Washed out by floods.
2	Umlyngka ...	Ka ka Kwai ...	1,362	1,305	1,008	
3	Mairang ...	Kmie ka Selina ...	1,677	1,656	1,533	
4	Kynshi ...	Ka Mar ...	1,341	1,316	675	
5	Kheim Mawrah ...	Kpa U Rubin ...	1,692	1,572	1,548	(*a*).
6	Mylliem ...	U Hira Shon ...	1,320	546	675	(*b*) damaged by flood.
7	Shangpung ...	U Simon Dhar ...	1,004	545	607	(*b*) damaged by flood.
8	Sutnga ...	U Laphon Barwon	...	...	...	Washed out by floods.
9	Jowai ...	U Tamon Nikhla	804	667	478	
10	Mawlyngkneng ...	Ka Sngit Lawai ...	606	571	353	

(*a*) average of two plots.

(*b*) average of three plots.

Two centres Nos. 1 and 8 were completely washed out by floods. Taking the average of the 8 remaining centres, the average increase over the untreated plots due to bonemeal is 366 lbs. and that due to flour phosphate is 162 lbs. of grain per acre.

Valuing the grain at Rs. 3 per maund, the average profit per acre in this the third year after application is Rs. 13-8 for bonemeal and Rs. 6 for flour phosphate. For the 3 years for which these demonstrations have now run, the total net profit is Rs. 39-12 and Rs. 19-4 per acre for bonemeal and flour phosphate respectively. This result represents a total net profit on the three years' working of 266 per cent. in the case of bonemeal and 143 per cent. for flour phosphate on an initial expenditure of Rs. 15 and Rs. 13-8 per acre for manure.

3. *Bone crushing operations, bonemeal distributions.*—On the strength of the foregoing results no apology will be necessary for our attempts to increase the amount of bonemeal available for sale at a cheaper rate than it can be imported from Calcutta.

The supply of raw bones in the hills districts is relatively small. Some 385 maunds were collected during the year, of which 307 maunds were crushed, yielding 283 maunds bonemeal, or 92 per cent. of the weight crushed, the remaining 8 per cent. being wastage.

This was disposed of as follows :—

		Maunds.				
Sold to Farm	...	28				
Used for demonstrations	...	14				
Sold at Farm ...	...	212	at	Rs.	3-8	per maund.
„ „ Jowai depôt	...	21	„	„	4-14	„ „
„ „ Marbisu „	...	8	„	„	3-10	„ „

The demand far exceeded the supply. To augment the supply of raw bones and increase the amount of bonemeal for sale, for which an annual demand of from 1,000 to 2,000 maunds now exists, arrangements are in hand to bring up from the plains some 500 maunds raw bones for grinding at the Farm. The rates which are offered will enable us to continue selling bonemeal at Rs. 3-8 per maund at Farm.

4. *Potatœs.*—Owing to the fact that the greater part of the imported varieties of potatoes grown at the Farm were required for famine operations in Sylhet and for demonstration purposes, only two depôts for the supply of seed potatoes were opened this year, one at Marbisu and the other at Jowai. The price of "seed" at the Farm was Rs. 2-12 per maund and at depôts Rs. 2-12 *plus* cost of freight from Farm. The total quantity sold was 296 maunds, of which 220 maunds were issued from the Farm and 76 maunds from the two depôts. King of potato and Magnum Bonum were the two chief varieties thus disposed of.

Demonstrations made in two centres, where potato cultivation is scanty, were not very successful owing to a long spring draught. At another centre, in Jowai, better results were obtained, and cultivation is being continued. Winter crops under the Department's supervision are being taken at the above centres, and better results may be hoped for.

Spraying with Bordeaux mixture.—The potato crop in the hills this year was practically free from blight, although in some places it was badly affected by draught. Only two acres of potatoes were sprayed by the Department's sprayers, against 12 acres last year. The majority of the cultivators do not yet appreciate the value of spraying, and are unwilling to bear the cost of it.

5. *Grafting of fruit trees.*—This was continued as usual, demonstrations being given by demonstrators on their tours.

The following grafts were made in 40 villages :—

Oranges	...	544	(budding)
Pears ...	...	418	
Peaches ...	...	189	
Apples ...	...	58	
Plums	...	42	
Apricots ...	...	43	
Nectarines	...	8	
Total	...	1302	

The oranges are budded on old limes and citrus stocks with the object of avoiding the desease which has threatened to wipe out the orange industry in these tracts. Up to date no signs of disease are apparent on the oranges so budded.

The two citrus nurseries mentioned in last year's report as having been made by cultivators for providing suitable stocks for orange budding, will provide such stocks next season. Another man at Shella has also made a small nursery for this purpose.

6. *Supply of seeds and plants.*—The following seeds and plants were distributed during the year outside the district :

				Mds.
Maize seed	...	...	...	8
Orange seedlings	...	...	...	1,000

7. *Pan disease.*—Specimens of diseased plants were sent to the Imperial Bacteriologist, Pusa, during the year. It is understood that investigations are in progress both by the Imperial Bacteriologist and the Imperial Mycologist.

8. *Garo Hills work.*—The proposed work on terrace cultivation at Demalgiri in the Garo Hills must await the end of the war. The demonstrator posted in the Garo Hills is supervising a small terracing experiment at Tura under the Deputy Commissioner there. Potato demonstrations are being commenced this year.

Dated Shillong,
The 15*th September* 1916. }

A. A. MEGGITT,

Deputy Director of Agriculture,
Assam Valley.

REPORT ON AGRICULTURAL DEMONSTRATIONS IN THE SURMA VALLEY DURING THE YEAR ENDING 30TH JUNE 1916.

Staff.—The Demonstration staff in the Surma Valley now consists of :—

(1) One Agricultural Superintendent, Mr. L. Barthakur. He joined the post on 29th June 1915.

(2) Two Agricultural Inspectors, *viz.*, Babu Binod Behari Das and Babu Surendra Nath Gupta. Binod Babu was confirmed in the post with effect from 1st December 1915 after having served on probation of two years and 8 months (*i.e.*, since 1st April 1913). Surendra Babu was promoted from the post of Overseer of the Karimganj Farm to the post of Agricultural Inspector with effect from 15th June last, and was placed in charge of demonstration work in the Karimganj subdivision and Cachar district. The remainder of the Sylhet district formed the charge of Babu Binod Behari Das. This arrangement was to have come into effect on the appointment of Babu Surendra Nath Gupta as Agricultural Inspector, but fell through in consequence of his being placed in charge of the Karimganj Farm within a few days of his appointment as Agricultural Inspector (*i.e.*, since 5th July). He has since continued in charge of the farm, and practically there has been only one Agricultural Inspector in the Valley during the year.

(3) One Demonstrator, Girindra Kumar Dey, appointed on 1st August 1915 after having worked as an apprentice at the Karimganj Farm for a period of 14 months (since 1st June 1914).

The staff is still far short of our requirements, especially as regards Demonstrators, of whom at present there is only one. The apprentices on the Karimganj Farm had to be requisitioned on several occasions to help in demonstration work and perform the duties of Demonstrators.

Short as the staff was, a considerable part of its time was spent during the year on work arising out of the great floods of 1915. The work consisted chiefly in making enquiries about the condition of the people, crops and cattle, and in procuring various kinds of seed for cultivators in the affected areas. Indeed the whole of the demonstration staff was kept employed on enquiry and seed supply, more or less continuously from the latter part of July till the end of March.

Below is stated the total number of days which was spent by each of the officers on this work :—

Agricultural Superintendent	...	...	79 days.
Agricultural Inspector	...	...	111 days.
Agricultural Demonstrator	...	...	70 days.

From this it will be seen that the small staff in the Surma Valley was kept engaged for a considerable time in work arising from the floods. Their absence, on flood duty, caused the demonstration work in Sylhet to suffer to some extent, but this could not be helped. On the other hand their employment on this duty gave the staff an opportunity of gaining an insight into the agricultural conditions of the district, which it might have taken them long to acquire otherwise, and brought them into sympathetic contact with many villagers whom they would not have otherwise met. At the same time the destruction of the rice crop by the floods opened the way for the introduction of crops like potatoes, linseed and wheat in localities where they had hitherto been unknown.

Kinds of demonstrations made.

2. The demonstrations made during the year were designed :—

(1) To show the value of bonemeal as a manure for the rice crop. This class of demonstration partakes to a large extent of the nature of experiment, since we cannot be sure that a phosphatic manure like bonemeal will pay on any given soil until it has been actually tested and found to be profitable.

(2) To show the superiority of the 3-roller sugarcane mill to the wooden country mill which is ordinarily used by thepeople.

(3) To show the superiority of English seed potatoes imported from the Khasi Hills compared with the local kinds.

Bonemeal as manure for rice.

3. Eleven new demonstrations were laid out during the year. Besides these, there were two demonstrations which had been organised in 1914-15 and in which the manured plots as well as their controls were kept under observation during the year in order to observe the residual effect of the bonemeal applied in 1914.

The new demonstrations were concentrated in a group of villages round Barlekha for facility of inspection. It was hoped that the red laterite soil of this tract would respond well to the action of a phosphatic manure like bonemeal.

Out of the 11 new demonstrations, 7 were designed to demonstrate the effect of bonemeal on the rice crop, and on the remaining 4 the value of green-munuring with *dhaincha* was to be demonstrated. The last four, however, failed in the initial stage. The *dhaincha* crop had been sown about the end of April and the beginning of May, but heavy rain soon after caused the soil to become water logged and prevented the crop from making a good start. It was decided, therefore, to break up the *dhaincha* and use bonemeal on the land. This was done. So, eventually, these four demonstrations became converted into demonstrations with bonemeal.

The heavy rain and floods of last season interfered seriously with the cultural operations. In some of the demonstrations, the land was overlaid with silt; some suffered from surface wash; and others more or less from the flood water remaining too long on the land.

The results of the demonstrations are exhibited in a statement annexed hereto.

TABLE I.

Locality.	Year when Demonstration was started.	Manures used per acre. A—Bonemeal 3 mds. B—Flour phosphate 3 mds. C—No manure.	Yield of paddy per acre.	Increase in 1915-16.	Increase in previous year.	Total Increase.	Value of increased produce at Rs. 2-8 per maund.	Cost of manure.	Remarks.
1	2	3	4	5	6	7	8	9	10
			Mds. srs. ch.	Mds. srs. ch.	Mds. srs. ch.	Mds. srs. ch.	Rs. a. p.	Rs. a. p.	
Chapghat	1914	A	23 1 0	23 1 0	10 36 0	33 37 0	84 13 0	12 0 0	*Aus* crop was spoiled by flood and *sail* not transplanted.
		C	...	...	...	...	...	...	
	"	B	20 33 0	20 33 0	5 26 0	26 19 0	66 3 0	7 8 0	Ditto.
		C	...	...	...	...	...	...	
Gaharpur	"	A	19 32 0	2 19 0	3 14 0	5 33 0	14 9 0	12 0 0	
		C	17 13 0	...	...	...	...	...	
Patharia	1915	A	18 32 0	1 39 0	...	1 39 0	4 15 0	12 0 0	
		C	16 33 0	...	...	...	...	...	
	"	A	18 34 0	0 11 0	...	0 11 0	0 11 0	12 0 0	
		C	18 23 0	...	...	...	...	...	
	"	A	28 2 0	2 6 0	...	2 6 0	5 6 0	12 0 0	
		C	25 36 0	...	...	...	...	...	

Chhotalekha	„	A	27 13 0	0 12 0	...	0 12 0	0 12 0	12 0 0
		C	27 1 0	...	...	...	...	...
	„	A	26 19 0	1 24 0	...	1 24 0	4 0 0	12 0 0
		C	24 35 0	...	...	...	...	...
	„	A	34 26 0	9 11 0	...	9 11 0	23 3 0	12 0 0
		C	25 15 0	...	...	...	...	...
	„	A	17 16 0	3 12 0	...	3 12 0	8 4 0	12 0 0
		C	14 4 0	...	...	...	...	...
	„	A	19 33 0	3 19 0	...	3 19 0	8 11 0	12 0 0
		C	16 14 0	...	...	...	...	...
	„	A	22 17 0	0 26 0	...	0 26 0	1 10 0	12 0 0
		C	21 31 0	...	...	...	...	...
	„	A	20 33 0	2 15 0	...	2 15 0	5 15 0	12 0 0
		C	18 18 0	...	...	...	...	...
	„	A	16 18 0	2 32 0	...	2 32 0	7 0 0	12 0 0
		C	13 36 0	...	...	...	...	...

In one of the two old demonstrations, the unmanured crop was wholly destroyed by flood, while manured land escaped unscathed and gave a satisfactory yield of grain. In the second, there was a fair increase in outturn (2 mds. 19 srs.) which, taken together with the increase obtained in the previous year, covered the cost of the bonemeal applied in 1914 and left a little profit besides.

As to the new demonstrations, there was a small increase in yield in every case, but the value of the increase fell short of the cost of the manure except in one case.

Although the effect of bonemeal is expected to last for several years, it will be idle to expect the cultivators to use any manure which will not return its cost in the first year and leave a handsome profit besides. None of the owners of the lands on which demonstrations with bonemeal were made last year seem willing to allow us to observe the residual effect of the bonemeal in the current year, but an effort will be made to pursuade them to let us continue the demonstrations.

A large number of demonstrations with bonemeal has been arranged for in the current year. In some of these, bonemeal is to be used in connection with *dhaincha* ploughed in as green manure. It is expected that *dhaincha*, besides being useful in itself, will lead to more speedy disintegration of the bonemeal and thus make it act more quickly.

The 3-roller sugar-cane crushing mill.

4. Demonstrations were made during the year at 2 centres, Sabajpur and Gramtola.

In the demonstration with the iron 3-roller mill the extractions varied from 58·8 to 64·4 per cent. as against 45 to 50·7 per cent. obtained with the wooden 2-roller mills, thus showing an improvement in yield of juice of at least one-third over the mills now used.

The cultivators who tried the 3-roller mill were favourably impressed with its efficiency and several persons at Gramtola expressed their intention to purchase mills of this type next year.

Owing to the fact that only small areas of cane are grown by individual cultivators in these districts and that the local cattle are small and ill-fed the mills at present in use are commonly worked by hand-power. The 3-roller mill can be modified for working by hand-power also, but it is desirable that it should be worked by bullock or buffalo power if the best results are to be obtained from its use.

Cultivation of English seed potatoes from Shillong.

5. The plan which was previously followed was to select a number of cultivators in different parts of the district and give them, free of cost, a quantity of seed potatoes for trial in their fields. As these seed potatoes could readily be used for eating or even for sale and it was found impossible with the small staff available to keep an eye on a large number of demonstrations scattered over the whole district this arrangement was discontinued.

In the beginning of the last potato season three temporary depôts were opened for the sale of Khasi Hill seed potatoes to cultivators at cost price. The three depôts were located at Motiganj, Mirpur and the Karimganj Farm. The total quantity of seed supplied to the depôts was 200 maunds and comprised the following kinds :—

	Mds.
Magnum Bonum grown on the Shillong Farm ...	100
King of Potatoes grown on the Shillong Farm ...	60
King of Potatoes grown on *jhum* land and purchased from cultivators near the farm.	40
Total ...	200

The original intention was to send out *jhum* grown seed only and we had arranged to purchase 200 maunds of it from Khasi cultivators in the neighbourhood of the farm. But these having backed out at the last moment we are obliged to supply farm-grown seed with the exception of some 40 maunds of *jhum* grown King of Potatoes which was all we were able to secure.

The seed was despatched from Shillong on the 8th September and had to be carried by cart as far as Cherrapunji, thence by coolies to Bholaganj, and thence by boat to the depôts. The transit took 11 or 12 days.

The result of the venture was singularly unfortunate. As soon as the seed arrived in the plains it began to rot rapidly, so much so that we were obliged to sell a part of what remained, some 44 maunds, for whatever it would fetch, and only some 30 maunds could be saved for sale as seed. Thus out of 200 maunds, only 73½ maunds were actually sold, fetching a sum of rupees 282-11-3. The total cost of the seed, inclusive of the value of 200 maunds of potatoes (rupees 500) supplied free by the Upper Shillong Farm, and of cost of transport and maintenance of the depôts, was rupees 1,103-7-6. A net loss of rupees 820-12-3 was incurred in consequence.

As to the causes of the unusual rotting, I am unable to speak with any assurance. It is possible the seed got wet in transit, though the Agricultural Inspector, Babu Binod Behari Das, who was in charge, says this was not the case. Other possible contributary causes were :—

(1) The unusual heat of last autumn (September and October 1915).

(2) The greater part of the seed had been raised on heavily manured land. Out of the 200 maunds of seed supplied, 160 maunds were the produce of the farm and were grown on land manured with cowdung and oilcake; the remaining 40 maunds came from *jhum* land. The latter lot showed less rottage than the former; the percentage of loss through rotting was 83 per cent. in case of farm-grown Magnum Bonum, 73 per cent. in case of farm-grown King of Potatoes, and 53½ per cent. in case of *jhum*-grown seed of the variety—King of Potatoes. The rottage of the *jhum*-grown seed, though much less, was still very considerable.

(3) Defective packing. The seed potatoes were sent packed in bags, each holding about 1½ maunds. This is the usual mode of packing when potatoes either for seed or for the table are sent down to the plains.

We shall have to guard against losses from these possible causes in future. Repeated experience has shown that for some reason the seed potatoes grown on the farm exhibit a greater tendency to rot when exported to the plains, though they keep and do quite well in the cooler climate of the hills. On the other hand, *jhum*-grown potatoes, which form the bulk of the seed potatoes annualy exported from the Khasi Hills to Eastern Bengal and Calcutta *viâ* Bholaganj, do not suffer much from rotting. It was for these reasons that I had arranged to supply only *jhum* grown potatoes to Sylhet district last year. We have arranged for a larger supply of *jhum*-grown seed potatoes next year; it is hoped that by greater care in packing and in transit most of this wastage through rotting may be avoided.

A register was kept showing the names and addresses of the persons who purchased seed from these depôts. Altogether 56 people obtained seed potatoes through these temporary depôts.

Mention has already been made of the seeds which this Department supplied last year to the flooded areas in the Sylhet district. These included 600 maunds of seed potatoes which we purchased at Bholaganj. The greater part of these 600 maunds went to the Kanairghat Tehsil in the Jaintia Parganas. As the potato crop was a new one to that district, the Agricultural Superintendent and the Agricultural Inspector travelled through the Tehsil during the time the crop was being planted to give instructions to the cultivators as to the proper methods of planting and cultivation.

It was intended that these two officers should visit as many as possible of the people who had obtained potato seed for the purpose of inspecting the crops during the potato-growing season and inquiring as to how the seed had grown. Neither of these officers was able to go at the proper time, as they were absent from the district. The Demonstrator was, however, able to pay a hurried visit to some of the cultivators. From his report it appears that in general the Khasi Hills seed potatoes were fairly successful in spite of the fact that the crop was a new one to many of the people.

It is possible that a demand for Shillong seed will arise again in those places which received seed last year and arrangements will be made to find out what seed is likely to be required and to obtain a timely supply.

Work in progress.

6. With the slightly larger staff of this year efforts have been made to widen the scope and area of our demonstration work. Upwards of 100 demonstrations have been arranged for the present year; they comprise the following :—

Bonemeal manuring on paddy, growth of *dhaincha* as green manure for paddy land, growth of Jowar for fodder, sugarcane cultivation, treatment of peaty soil with lime, growth of improved seed of jute and the cultivation of ground nuts.

These demonstrations are distributed over the districts of Sylhet, Barlekha, Shaistaganj, Shahajibazar, Bhatera, Kalagool and Bejura. The results of these experiments will not be available for some time.

The above report was prepared by Rai Bahadur B.C. Basu before his retirement.

CAMP KARIMGANJ :
The 31*st July* 1916.

J. W. McKAY,
Deputy Director of Agriculture,
Surma Valley.

A. S. P. O. (D. L. R.—Agri.) No. 66—500—14-12-1916.—B. C. Singh.

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